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Rutherford
ELECTRONICS CO.

INSTRUCTION BOOK

PULSE GENERATOR
MODEL B-2A

Serial No._____

8944 LINDBLADE ST., CULVER CITY, CALIF.

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B-2A PULSE GENERATOR

GENERAL DESCRIPTION

The RUTHERFORD MODEL B-2A PULSE GENERATOR is a general purpose, precision instrument whose function is to produce synchronizing pulses at various times relative to one another, and to produce a main pulse over which one has very fine control of repetition rate, delay, pulse width, and amplitude. Further, our MODEL B-2A PULSE GENERATOR pproduces this pulse with good rise and fall times, a flat top at low impedance - and - with good resolution.

These desirable features result from the use of precision and quality components wherever necessary to insure peak performance.

SPECIFICATIONS

INTERNAL OSCILLATOR

Ranges -				
X100	100 KC	to	10 KC
X10	10 KC	to	1 KC
X1	1 KC	to	100 Cycles
X.1	100 Cycles	to	10 Cycles

Dial Calibration - 1000 divisions per range.

Accuracy - ± 2% except 10 to 100 KC range.

Single Pulse - A push button provides a single pulse at each of the outputs.

External Trigger Input - A positive or negative pulse of 6 volts minimum with a rise time of 2 microseconds will trigger the pulse generator. Another representative figure is 10 volts with 6 microseconds rise time.

POSITIVE SYNC PULSE - Blocking oscillator pulse output through a cathode follower.

Voltage, Open Circuit - At least 20 volts.

Rise Time - .2 microsecond or less.

Width - Approximately .5 microsecond.

Internal Impedance - 470 ohms.

Blocking Condenser - .01 mfd., 500 volts.

POSITIVE DELAYED SYNC PULSE - Blocking oscillator pulse output through a cathode follower separated from POSITIVE SYNC PULSE by approximately 2 microseconds.

Voltage, Open Circuit - At least 12 volts

Rise Time - .2 microsecond or less.

POSITIVE DELAYED SYNC PULSE (continued)

Width - Approximately .5 microsecond.

Internal Impedance - 470 ohm.

POSITIVE SYNC PULSE APPROXIMATELY 1 MICROSECOND BEFORE MAIN PULSE -
Blocking oscillator pulse output through a cathode follower.

Volts, Open Circuit - At least 20 volts

Rise Time - .2 microsecond or less

Width - Approximately .5 microsecond.

Internal Impedance - 470 ohm.

Blocking Condenser - .01 mfd., 500 volts.

POSITIVE PULSE AT LEADING EDGE OF MAIN PULSE -
Blocking oscillator pulse output through a cathode follower, separated from POSITIVE SYNC PULSE APPROXIMATELY 1 MICROSECOND BEFORE MAIN PULSE by a fixed delay line.

Voltage, Open Circuit - At least 15 volts.

Rise Time - Approximately .5 microsecond.

Internal Impedance - 470 ohm.

Blocking Condenser - .01 mfd., 500 volts.

POSITIVE PULSE AT TRAILING EDGE OF MAIN PULSE -
Blocking oscillator pulse from cathode of blocking oscillator.

Voltage, Open Circuit - At least 25 volts.

Rise Time - .2 microsecond or less.

Width - Approximately 1 microsecond or less.

Internal Impedance - 100 ohms. Note: Loading this output will increase the fall time of the main pulse.

Blocking Condenser - .01 mfd., 500 volts.

MAIN PULSE

Width Ranged -

.1	to	1	microsecond
1.0	to	10	microseconds
10.	to	100	microseconds
100.	to	1000	microseconds.

MAIN PULSE (Continued)

Accuracy - ±2%, except 1 microsecond range.

Jitter of Trailing Edge with Respect to Leading Edge - .01% maximum

Effect of Line Voltage - Variations from 105 to 125 volts change the pulse width by .4% maximum.

Dial Calibration - 1000 division per range.

Duty Factor - Limited by the disipation capabilities of the output tube to 25%.

Step Attenuator - Five constant impedance, 93 ohms, Pi sections of 10 db. each in series.

Amplitude Control - 10 db. variable attenuator.

Amplitude - At least 40 volts across a 93 ohm load, internal or external.

Internal Impedance - 93 ohm maximum

Rise Time, 10% to 90% points - .02 microsecond or less.

Fall Time 10% to 90% points - .02 microsecond or less.

Over and Undershoot - Less than 4% with matched load.

Polarity - Plus or minus, but not simultaneously.

Blocking Condenser - None on positive pulses. 125 mfd electrolytic on negative pulses. Maximum external voltage with negative output pulse 0 to 400 volts.

Top of Pulse, Droop - Can be adjusted to within ±5%

$$\frac{\%\ \text{Droop}}{100} = \frac{\text{Leading Edge Amplitude} - \text{Trailing Edge Amplitude}}{\text{Leading Edge Amplitude}}$$

INTERNAL DELAY - Measured between the 20% points of the POSITIVE DELAYED SYNC PULSE and MAIN PULSE. When an external trigger is used as a reference the internal delay of the triggering system, approximately 2 microseconds, must be added to the delay reading.

Ranges -	0	to	1 microsecond
	1	to	10 microseconds
	10	to	100 microseconds
	100	to	1000 microseconds
	1000	to	10,000 microseconds

INTERNAL DELAY (CONT'D)

Jitter - .01% or less.

Accuracy - ±1%, except 1 microsecond range.

Effect of Line Voltage - Variations from 105 to 125 volts change the delay by 0.4%.

Duty Factor Effects - Minimum recovery time 1½ μsec.

Error due to high duty factors; representative table for 1000 μsec. range.

Duty Factor	Percent Error
0.5%	0.0 (Reference)
5	0.1
50	0.4
90	3.2
95	5.0
97	5.5

This does not imply that the error will be the same for all ranges with the same duty factor.

Calibration - 1000 divisions per range.

CONTROLS

On-Off (Power)
Repetition Rate Range and External
Repetition Rate Dial
Single Pulse Switch
Delay Range
Delay Dial
Pulse Width Range
Pulse Width Dial
Main Pulse Polarity Switch
Attenuator Matching Resistor In-Out Switch
Attenuator 10db. In-Out Switches (Five)
Amplitude Control

CONNECTORS

Input and Outputs - SO239 Video Type, may be fitted by customer with UG 273/U adaptors for BNC connectors.

Power Cord - Standard NEMA 3 wire with ground pin.

POWER - 110 or 220 volts, 50-60 cycle, 300 watts. Standard units are wired for 110 volt operation.

SIZE - Standard 14" X 19" front panel for rack mounting; supplied with cabinet 14" X 19" X 18", overall. Weight - 64 lb.

CALIBRATION - Each range of the Oscillator, Delay, and Pulse Width is accurately calibratable by use of separate potentiometer adjustments which change only a D. C. voltage level not involving signals, thus giving non-critical adjustment.

ACCESSORIES SUPPLIED
Four (4) Extension Cables for plug-in chassis.
Instruction Manual.

DESCRIPTION OF FRONT PANEL CONTROLS AND OUTPUTS

ON-OFF SWITCH - Controls A. C. power input.

PILOT LIGHT - Indicates power is being supplied to the instrument.

FUSE - 4 amp. Slo-Blo fuse protection for instrument for 110 volt operation. For 220 volt operation use 2 amp. Slo-Blo.

BLOWN FUSE INDICATOR - Indicates, when illuminated, that the fuse is open.

SINGLE SHOT PUSH BUTTON - Produces a step function which triggers the generator once each time operated. Use ONLY when FREQUENCY RANGE SWITCH is in the "external" position and the ± EXTERNAL TRIGGER SELECTOR SWITCH is in the + position.

FREQUENCY RANGE SWITCH - Switches condensers in the repitition rate oscillator to give decade frequency ranges.

FREQUENCY - Helical potentiometer which changes the potential of the grid return in the oscillator to give a continuously variable frequency. Determines pulse period along with FREQUENCY RANGE SWITCH. Frequency in cycles per second.

TRIGGER, EXTERNAL JACK - External trigger input, to be used ONLY when FREQUENCY RANGE SWITCH is in the "external" position.

TRIGGER SENSITIVITY - Adjusts the amplitude at which triggering occurs.

POSITIVE SYNC PULSE - Blocking oscillator pulse, to be used as a reference pulse.

POSITIVE DELAYED SYNC PULSE - Positive sync pulse delayed approximately 2 μsec. by a fixed delay line, to be used as a reference pulse. The calibrated Internal Delay is with reference to this pulse.

DESCRIPTION OF FRONT PANEL CONTROLS AND OUTPUTS (CONT'D)

DELAY RANGE SWITCH - Determines the delay range, in microseconds, of the main pulse with respect to the delayed sync pulse by switching the Miller Integrator constants.

DELAY - Helical potentiometer which varies the D. C. comparator voltage to give a continuously variable delay.

POSITIVE PULSE APPROXIMATELY 1μSEC. BEFORE LEADING EDGE OF MAIN PULSE - Blocking oscillator pulse that moves with the main pulse and precedes the main pulse by approx. 1μsec., to be used as a triggering pulse.

POSITIVE PULSE AT LEADING EDGE OF MAIN PULSE - Blocking oscillator pulse that moves with the main pulse and occurs at the time of the leading edge of the main pulse.

PULSE WIDTH RANGE - Determines the pulse width range, in microseconds, by switching the Miller Integrator constants.

PULSE WIDTH - Helical potentiometer which varies the D. C. comparator voltage to produce a continuously variable width pulse calibrated in microseconds.

MAIN PULSE - Variable width, variable delay, variable amplitude pulse of either positive or negative polarity. Maximum output impedance - 93 ohms.

MAIN PULSE $\pm$ SWITCH - Switches resistors in the output tube circuit to obtain positive or negative pulses.

AMPLITUDE CONTROL - Fill in amplitude control which varies amplitude at least 10db.

STEP ATTENUATOR, EACH SWITCH - Cuts in or out at constant impedance Pi section with an attenuation of 10db per section. Total attenuation is obtained by adding together the attenuation of sections "IN".

TERMINATING RESISTOR - Switches in or out a 93 ohm resistor to terminate the PULSE GENERATOR, should be "IN" when high impedance load is used and should be "OUT" when 93 ohm load is used.

OPERATING INSTRUCTIONS

The following sequence is suggested in placing the instrument in operation for the first time.

1. Turn the power switch on.

OPERATING INSTRUCTIONS (continued)

2. Place the Frequency Range Switch in the X10 position and the FREQUENCY DIAL in the 100 position. The repetition rate period is:

$$\frac{1}{1000 \text{ cps.}} = .001 \text{ second or } 1000 \text{ microseconds.}$$

3. Trigger the Synchroscope sweep from the Positive Synchronizing Pulse.

4. Set the DELAY RANGE SWITCH to the 100 microsecond range.

5. Set the PULSE WIDTH RANGE SWITCH to the 100 microsecond range.

The variable delay with resepct to the POSITIVE SYNC PULSE and the variable pulse width can be observed as functions of the DELAY and PULSE WIDTH dial settings.

> N O T E
> The maximum pulse width is limited to approximately 25% of the repetition rate period. (See the section on LIMITATIONS OF PULSE GENERATOR.)

To obtain the best possible wave shape from the output it is imperative that a matching load be applied at the end of the transmission line. For instance, if an unterminated cable is connected to the output, the wave shape will have considerable overshoot and undershoot. The matching resistor in the attenuator will not serve to remove this overshoot since the mismatch is at the other end of the cable. The use of 93 ohm co-acial cable is recommended, and when properly terminated with the MATCHING RESISTOR "OUT" provides the proper load for the five 10 db. step attenuators.

PRINCIPLES OF OPERATION

EXPLANATION ON BASIS OF SIMPLIFIED BLOCK AND TIMING DIAGRAM (B2-A-1116)

A Phantastron oscillator or external trigger determines the repetition rate of all of the outputs of the B-2A PULSE GENERATOR. The output of the oscillator or trigger amplifier is fed into the shaping circuit; the outputs are the negative pulse to the delay circuit, the SYNC PULSE (1), and DELAYED SYNC PULSE (2). The outputs of the delay are a positive pulse to the pulse forming circuit, a negative pulse to the

PRINCIPLES OF OPERATION (continued)

pulse width circuit, the PULSE APPROX. 1 MICROSECOND BEFORE LEADING EDGE OF MAIN PULSE (3), and the PULSE AT LEADING EDGE OF MAIN PULSE (4). The output of the pulse width circuit is a positive pulse to the pulse forming circuit. The outputs of the pulse forming circuit are the PULSE AT TRAILING EDGE OF MAIN PULSE (5) and the MAIN PULSE (6 or 7).

For internal operation a double Phantastron oscillator is used as the frequency source. The complex plate wave from a chathode follower is differentiated and the positive pulse used to trigger the blocking oscillator. For external operation a cathode coupled amplifier is employed, and its positive output pulse is used to trigger the blocking oscillator. The single pulse switch provides a positive trigger at the input to the cathode coupled amplifier for single shot operation. The positive output of the blocking oscillator is fed to a cathode follower, the output of which is the SYNC PULSE output, and to a 2 microsecond delay line. The delayed output of the line is fed to another cathode follower and thence, to the DELAYED SYNC PULSE output. A negative pulse from the blocking oscillator is used to start the DELAY CHASSIS circuits.

All of the above mentioned operations take place physically in the SYNC-FREQUENCY CHASSIS and associated front panel controls.

The negative blocking oscillator pulse from the SYNC-FREQUENCY CHASSIS triggers the flip-flop in the DELAY CHASSIS which gates on the Miller integrator, starting the negative going triangular wave. The negative going voltage is applied to one grid of the comparator, while the output of the helical potentiometer is applied to the other grid. When both voltages are approximately equal a negative pulse is formed by the comparator, which, after being amplified, triggers a blocking oscillator. A negative pulse from the blocking oscillator is used within the DELAY CHASSIS to retrigger the flip-flop, and hence, reset the delay circuits, readying them for another input pulse from the SYNC-FREQUENCY chassis. The negative pulse from the blocking oscillator is also used to trigger the flip-flop of an indentical circuit which determines the width of the main pulse. A positive pulse from the blocking oscillator is applied to a cathode follower and to a fixed delay line. The output of the cathode follower is fed to a jack on the front panel and is the POSITIVE PULSE APPROXIMATELY 1 MICROSECOND BEFORE LEADING EDGE OF MAIN PULSE. The output of the delay line goes to the PULSE FORMING CHASSIS and to another cathode follower which supplies the POSITIVE PULSE AT THE LEADING EDGE OF THE MAIN PULSE.

As mentioned before, the PULSE WIDTH CHASSIS is the same in all respects as the DELAY CHASSIS; however, in

PRINCIPLES OF OPERATION (continued)

addition to the blocking oscillator output, a negative gate from the flip-flop is taken as an output into the PULSE FORMING CHASSIS.

In the PULSE FORMING CHASSIS the discharge tubes are biased well below cut-off while the clamp tube is biased at zero volts and, hence, maintains the charge on the pulse forming condensor, "C", at zero between pulses. The negative gate from the PULSE WIDTH CHASSIS gates off the clamp tube and readys "C" to receive the charging current pulse. About one microsecond later, the positive pulse from the delay line triggers the input blocking oscillator, which in turn triggers the pulse forming blocking oscillator charging "C" to a positive voltage. The cathode follower couples the charge on "C" to the output tube grid. The pulse from the PULSE WIDTH CHASSIS triggers the trailing edge blocking oscillator which applies a positive pulse to the grids of the discharge tubes. One of the discharge tubes draws current from "C" returning it to zero volts while the other discharge tube discharges the stray capacitance of the output tube grid circuit. The main pulse is taken from the cathode or plate of the output tube for positive and negative pulses respectively and is passed through the constant impedance attenuator to the front panel output jack.

The REGULATOR CHASSIS provides the necessary regulated voltages.

CIRCUIT DESCRIPTION

The Schematic (B2-N-1130) shows the combined circuitry and should be referred to in the following discussion.

FREQUENCY - SYNCHRONIZING CHASSIS

A double cathode coupled phantastron oscillator is used to give the greatest timing accuracy available with a high degree of linearity. The timing is determined on both halves of the cycle by a linear waveform. To explain this circuit, let us consider only half of the circuit consisting of V-101 and V-106a. If a negative voltage is applied to the suppressor grid of V-101, the plate current will be shut-off and the plate voltage will rise to the supply voltage. Since the grid return voltage is positive, the screen will conduct heavily, causing the cathode voltage to rise. Now, if the suppressor voltage is raised to a value permitting the plate to conduct, the plate voltage will start to drop. This drop is coupled through the cathode follower (V-106a) and C-801, 803, 805, or 807 to the grid of V-101, and as soon as the grid reaches a voltage near cut-off, the rapid plate voltage fall will be replaced with a Miller run down. During this Miller action, the grid will remain near cut-off; hence, the cathode current will be small and very little voltage will be developed across the cathode resistor. As soon as the plate bottoms-- reaches a voltage below which it can not go-- the grid voltage will

FREQUENCY - SYNCHRONIZING CHASSIS (CONT'D)

begin to rise and the cathode will follow. To sum up the important points, a negative voltage on the suppressor grid caused the plate to go positive, the screen to draw current, and a positive voltage to be developed across the cathode resistor. A positive voltage on the suppressor caused a Miller run down and very little voltage across the cathode resistor until the plate bottomed, when the cathode voltage began to rise. Now, to put the two halves together, suppose that V-102's plate is cut off by its suppressor while V-101 is in the Miller run down part of its cycle. As soon as the plate of V-101 bottoms, the cathode starts to rise; this is the voltage we need to start the Miller action in V-102; also as soon as the Miller action starts, V-102's cathode voltage drops and this is the voltage we need to cut off the plate of V-101. Cross coupling from the cathodes to the suppressor grids of V-101 and V-102 will, therefore, give an oscillator with a period equal to the sum of the run down times of the two tubes. The run down time is proportional to the size of the plate to grid coupling condensors and inversely proportional to the grid return voltage. In this circuit the range is determined by switching the condensors and the fine frequency is determined by grid return voltage as determined by the helical potentiometer.

The complex plate waveshape is taken from the cathode follower (V-106B) and differentiated; the resulting pulses are applied to the trigger tube of the blocking oscillator, V-104. The negative pulse from the plate of the blocking oscillator triggers the flip-flop used in the following delay circuits. The positive pulse from the cathode of the blocking oscillator provides, through a cathode follower, the POSITIVE SYNC PULSE and, through a 2 sec. delay line and cathode follower, the POSITIVE DELAYED SYNC PULSE. Delaying the synchronizing pulse permits calibrating delays down to zero μ sec.

For external triggering, a cathode coupled amplifier is used so that input pulses of either polartiy can be accepted. The positive output of the amplifier is coupled to the Schmidt trigger tube (V-107). This tube has adjustable bias so that the trigger sensitivity can be varied. The positive output of the Schmidt trigger is coupled to the blocking oscillator through a differentiating network. For single shot operation a push button applies a positive-going voltage to the input of the cathode coupled amplifier.

IMPORTANT
FOR SINGLE SHOT OPERATION, THE FREQUENCY RANGE SWITCH MUST BE ON EXTERNAL, AND THE EXTERNAL ± SWITCH MUST BE ON +.

DELAY CHASSIS

The delay system used consists of four major units - flip-flop, screen coupled Miller integrator, comparator, and trigger forming blocking oscillator.

The delay system works as follows. Initially, the pin 1 plate of V-201 is conducting fully and is at approximately -35 volts. This is sufficient to cut off plate current. The clamping diode, V-202A, assures that the plate of V-203 will start at +225 volts. The comparator, V-204, is such that the left hand side is conducting at constant current due to V-205A, and the right hand side is below cut-off at a voltage determined by the helical potentiometer setting. The negative pulse from the SYNC-FREQUENCY CHASSIS triggers the flip-flop, V-201, causing the pin 1 plate to go positive, gating on the screen grid of the Miller tube. This circuit acts in just the manner previously described in the oscillator section, and a very linear triangle results at the plate. This negative triangle is coupled to the comparator grid, pin 2. The left hand side of V-204 acts as a cathode follower and the negative triangle will eventually run into the grid base of the right hand side of V-204. The constant current, flowing in V-205A, now shifts regeneratively to the right hand side, causing the RLC load in the plate to ring. After the first half of the oscillation, the diode clamps out the positive going pulse and a negative spike is left to be amplified in V-205B and then trigger the blocking oscillator V-206. The blocking oscillator pulse now retriggers the flip-flop to ready it for the next cycle. A number of advantages are obtained by use of this circuit. The two most important are given below.

1. The delay duty cycle is limited only by the recharging time of the delay condenser which is recharged via the cathode follower, one half of V-204.

2. Very fast delay ranges can be obtained; since the only limitations are on how fast the Miller tube can be gated and how much grid current the Miller tube is capable of drawing.

PULSE WIDTH CHASSIS

The pulse width delay circuitry is a duplication of the delay circuit described above.

PULSE FORMING CHASSIS

Initially the charge on C-305 is zero as determined by the clamp tube, V-304. About 1 μsec. before the start pulse, a negative gate is applied to the grid of the clamp tube,

PULSE FORMING CHASSIS (CONT'D)

cutting it off and readying C-305 to receive a charge. The start pulse triggers a blocking oscillator which, in turn, triggers the pulse forming blocking oscillator, V-302, which charges C-305 to about 200 volts. This charge is coupled to the output tube, V-307, by the cathode follower, V-303A. The stop pulse triggers the blocking oscillator, V-306, which applies a very positive voltage to the grids of the discharge tubes, causing them to draw current. The current through discharge tube V-305, returns the charge on C-305 to zero while the discharge tube V-303B, discharges any stray capacitance in the output tube grid circuit. The diode, V-308, provides D. C. restoration so that the base of the pulse coupled through via C-312 will also start from the same level, as determined by the amplitude control potentiometer, R-814. The output tube, V-307, is a 3E29, which is used as a cathode follower or inverting amplifier.

The attenuator is a constant impedance, 93 ohm, Pi network with five (5) sections of 10db. each, for a total attenuation of 50db. The variable amplitude is obtained by varying the D. C. restoration voltage on the 3E29 tube.

REGULATOR

The regulators used are of the conventional series tube, negative feedback type which use as their reference a 5651 voltage reference tube, V-401. The four regulated voltages obtained are -150, +225, +400, and a doubly regulated +225.

LIMITATIONS OF THE B-2A PULSE GENERATOR

PULSE WIDTH

Pulse width is limited by the capabilities of the 3E29 tube. Operation of this tube under the conditions in this equipment indicates that a 25% duty factor is about its limit. Cathode sagging - i.e. with a perfectly square grid pulse the cathode voltage sags as if a coupling condenser were too small - and the availability of high capacity condensers needed to couple wide pulses into a 93 ohm load limits the maximum pulse width to about 1000μsec.

PULSE DELAY

Pulse delay is limited to approximately 90% duty factor (varies with delay range) by the recharging time of the triangle generator and several small inherent delays of the triggering circuits.

MAINTENANCE AND ADJUSTMENT

REMOVAL OF CABINET

Remove the eight (8) screws holding the front panel to the cabinet and the three (3) screws at the rear. Remove the fan plug from the back of the unit. Pull unit from cabinet by the front panel handles.

REMOVAL OF PLUG-IN UNITS.

Turn the B-2A PULSE GENERATOR on its side so that the bottom is available. Turn the "Dzus" fastener on the desired unit counterclockwise and hold away from the chassis while pulling the plug-in unit out toward the back of the instrument.

CLEANING

The air filter must be kept clean to provide adequate cooling of the instrument. A washable filter is used. The following filter cleaning instructions are given by the filter manufacturer.

"To clean:

(1) If grease or dirt load is light, remove filter from installation and flush dirt or grease out of filter with a stream of hot water or steam.
(2) If load is too heavy for treatment in (1) above, prepare mild soap or detergent solution in pan or sink deep enough to cover filter when laid flat. Agitate filter up and down in this solution until grease or dirt is loosened and carried off filter.
(3) Rinse filter and let dry.
(4) Dip or spray filter with fresh Filter Coat, or other approved adhesive. Filter Coat is available from the local representative of RESEARCH PRODUCTS CORP., in the one pint Handi-koter with spray attachment or one gallon and five gallon containers. "

At regular intervals, any dust that should settle on the interior of the instrument should be removed by means of dry compressed air. Avoid a high velocity air stream which might injure the instrument or disturb adjustments. Persistent dirt may be removed with a lint free cloth and, if necessary, carbon tetrachloride.

Under normal conditions, the silver plated contacts of the rotary switches should not require special attention. In case they become tarnished, the contacts should be cleaned by rotating the switch several times.

MAINTENANCE AND ADJUSTMENT (CONT'D)

INSPECTION

A visual inspection is desirable while the B-2A PULSE GENERATOR is being cleaned.

SWITCHES - Turn the rotary switches while observing the contacts to check contact centering in each index position. Improperly centered contacts may be due to the switch being warped or twisted. AVOID pressure on the contacts as they are easily damaged.

CAPACITORS AND RESISTORS - Inspect the electrolytic capacitors for leakage of electrolyte, replacing if necessary. The wax coating of paper tubular capacitors may drip if the instrument has been overheated by operating in a restricted space or with a dirty air filter. This condition usually does not indicate replacement. Composition resistors should be checked for serious discoloration which would indicate excessive dissipation and, therefore, faulty operation. A moderate amount of discoloration is normal.

CONNECTIONS - Loose screws or nuts should be tightened. This is especially important when the screw serves as an electrical connector. Corrosion of the chassis and electronic components is unlikely under normal conditions. Corrosion should be removed, if evident, and the cause corrected. If the instrument must be used in a corrosive atmosphere, it may be desireable to remove the tubes occasionally and clean the contact pins with crocus cloth. Then remove and insert the tubes several times to clean socket contacts.

TROUBLE SHOOTING AND REPAIR

It is important that the operation, circuit theory, and physical location of the components be thoroughly understood before repair of the model B-2A PULSE GENERATOR is undertaken. If the Circuit Description and Schematic Diagram are carefully studied, most defects will be found easy to locate.

C A U T I O N

Be sure to check the setting & adjustment of the controls before attempting to repair, to verify that the difficulty is actual.

Although tables of average voltage and resistance values are included to facilitate servicing, they should be used for reference ONLY, and ARE NOT meant to serve as a "Check List" or sequence chart for circuit testing. This system might eventually lead to the trouble, but the isolation or signal tracing methods are usually much faster.

TROUBLE SHOOTING AND REPAIR (CONT'D)

Since a large percentage of troubles experienced with electronic equipment is caused by defective tubes, it is advisable to check the tubes in suspected circuits prior to conducting extensive tests of other components.

CALIBRATION

It is recommended that at least thirty (30) minutes warm-up preceed any calibration. All calibration adjustments for Frequency, Delay, and Pulse Width are located together on the right hand side panel, facing the front panel.

FREQUENCY - Rough frequency calibration should be made by comparison at the beginning of, for example, the leading edge of the main pulse to the leading edge of the main pulse on the next cycle with the calibration of the synchroscope. This would give an approximate accuracy of ten percent (10%).

Fine calibration should be made with reference to a crystal osillator. It is recommended that this be done with a pulse type calibrator. Suggested procedure for calibrating the 100 KC range is as follows:

Synchronize the sweep circuits of the synchroscope from the calibrator, using the 100 KC (10 μsec.) output. In general the pulse will move, either to the right or to the left, showing that the frequency is not identical to the standard. The helical potentiometer dial should be set to read 1000. Potentiometer #1 is now turned until the pulse which is observed has stopped moving in either direction. The helical potentiometer is now turned to read 100; the 10 KC trigger from the calibrator is used to start the synchroscope sweep, and the potentiometer #5 is used to stop the observed pulse from moving. Check the 100 KC again; since, moving the lower potentiometer causes the upper one to change slightly. This is, however, a converging process, and calibration to any required degree can be obtained. Calibration of the other ranges is a repetition of the above procedure.

The universal electronic timer and counter can also be used for these adjustments, and when available is desired.

DELAY - The delay is calibrated by comparison with a signal of known accuracy through the medium of a synchroscope. For the one microsecond range the synchroscope is calibrated from the standard signal so that the sweep covers the width of the graticule in one μsec. The synchroscope is then triggered from the DELAYED POSITIVE SYNC PULSE. The synchroscope input is then connected to the DELAYED POSITIVE SYNC PULSE and the horizontal position control adjusted so that the 20% point (or any other point) of the sync pulse coincides with the left edge of the graticule. Then with the dial set at 1000 the lower delay potentiometer (#16) is adjusted so that the 20% point of the MAIN PULSE coincides with the right edge of the graticule.

CALIBRATION (CONT'D)

The zero delay should then be readjusted and then again the one μsec. setting since there is interaction between the controls; however, this is a converging process and the required accuracy is reached with but a few adjustments of the upper and lower potentiometers. The 10, 100, 1000, and 10,000 μsec. ranges are calibrated in the same manner except that the upper potentiometers are adjusted for a one-tenth full scale setting of the helical potentiometer instead of zero. This necessitates calibrating the synchroscope for both the one-tenth and full scale settings of each range.

The electronic timer can be used for these adjustments and where available is desirable.

PULSE WIDTH - The pulse width is calibrated the same way as the delay except that the one μsec. range is calibrated at two-tenths (2/10) full scale instead of at zero. The width of the output pulse can be observed on the calibrated sweep of the synchroscope using the internal trigger; this reduces the required switching in calibrating the synchroscope.

PULSE SHAPE - The four adjustments which affect the main pulse shape are the "droop" adjustments, C-317 and C-318, both located on the top of the pulse forming chassis, the "overshoot" adjustment, C-319, and the "pulse flatness" control, R-331, both located on the rear of the pulse forming chassis. These adjustments affect the main pulse shape as follows; C-319 the overshoot (approx. 0.1μsec. duration) of the leading edge, C-318 balances out a short duration hook (approx. 0.2μsec. duration) near the leading edge, C-317 balances out a longer duration hook or exponential droop (approx. 0.4μsec. duration) near the leading edge, and R-331 balances the very long time droop. All adjustments should be made for the flattest pulse.

When adjusting C-318 and C-319, a fast sweep must be used (0.1μsec./cm.), while a slower sweep (1.0μsec./cm.) should be used when adjusting C-317. R-331 should be adjusted using the 1000μsec. wide pulse. Due to slight interaction between the three trimmer capacitors, each adjustment should be made several times for best pulse shape.

C A U T I O N

The potentials and resistances listed in the following tables are average values. Many of them will exhibit considerable normal variation with different individual instruments due to manufacturing tolerances of the components and tube characteristics. Therefore, these tables should be used only in conjunction with careful study of the Circuit Description and Maintenance sections and the Schematic Diagram.

Unless otherwise specified, the readings were taken with the tubes in their sockets and the controls set as follows:

FREQUENCY RANGE	-EXTERNAL
DELAY RANGE	-1 μ SEC.
PULSE WIDTH RANGE	-1 μ SEC.

A D. C. voltmeter of 20,000 ohms per volt sensitivity was used for all D. C. voltage measurements. All voltages (D. C.) were measured with respect to ground, and are positive unless otherwise specified. All measurements taken with the plug-in units in the main chassis.

VOLTAGE & RESISTANCE CHART

FREQUENCY-SYNC CHASSIS

TUBE	TYPE	PIN	VOLTAGE	RESISTANCE	REMARKS
V-101	6AS6	1 2 3 4 5 6 7	0.0V 7.4V 0.0V 6.3V AC 135 V 215 V 7.6V	GND. 5K GND. FIL. 65K 17.5K 5K	
V-102	6AS6	-	-	-	SAME AS V-101
V-103	12AT7	1 2 3-8 4-5-7 6 9	180 V 0.0V 1.3V 0.0V 185 V 6.3V AC	15K 1MEG 12K GND. 15K FIL.	
V-104	12AT7	1-6 2 3-4-5 9 7 8	225 V -11 V 0.0V 6.3V AC -7 V 0.1V	11K 20K GND. FIL. 4.4K 370 OHM	
V-105	12AU7	1-6 2 3 4-5 7 8 9	225 V 0.1V 8 V 0.0V 0.1V 8.4V 6.3V AC	11K 370 OHM 1K GND. 600 OHM 1K FIL.	
V-106	12AU7	1-6 2 3 4-5 7 8 9	225 V 135 V 135 V 0.0V 145 V 145 V 6.3V AC	11K 65K 10K GND. 65K 11K FIL.	
V-107	12AT7	1 2 3-8 4-5 6 7	145 V 13 V 46 V 0.0V 225 V -0.1V	25K 4.7MEG 10K GND. 19K 240K	

VOLTAGE & RESISTANCE CHART

DELAY & PULSE WIDTH CHASSIS

TUBE	TYPE	PIN	VOLTAGE	RESISTANCE	REMARKS
V-201	5687	1	-100 V	16K	
		2	-110 V	11K	
		3-6	-110 V	4.5K	
		4-5	0.0V	GND.	
		7	-130 V	11K	
		8	6.3V AC	FIL.	
		9	75 V	16K	
V-202	6AL5	1	225 V	20K	
		2	-100 V	16K	
		3	225 V	10K	6.3V AC WITH RESPECT TO PIN #4.
		4	225 V	10K	6.3V AC WITH RESPECT TO PIN #3.
		5	70 V	60K	
		6	0.0V	GND.	
		7	225 V	250K	
V-203	5763	1	225.0V	250K	
		2			NO CONNECTION
		3-4-7	0.0V	GND.	
		5	6.3V AC	FIL.	
		6	-100 V	16K	
		8-9	3.2V	165K	
V-204	12AU7	1	325 V	220K	
		2	225 V	250K	
		3-8	227 V	INF.	
		4-5	225 V	10K	6.3V AC WITH RESPECT TO PIN #9.
		6	400 V	195K	
		7	50 V	70K	
		9	225 V	10K	6.3V AC WITH RESPECT TO PINS 4-5.
V-205	12AU7	1	227 V	INF.	
		2-8-9	0.0V	GND.	
		3	7.7V	22K	
		4-5	6.3V AC	FIL.	
		6	95 V	19.5K	
		7	0.2V	2MEG	
V-206	12AU7	1-6	225 V	10K	
		2	-36 V	18K	
		3-9	0.0V	GND.	
		4-5	6.3V AC	FIL.	
		7	-24 V	3.75K	
		8	0.0V	450 OHM	

VOLTAGE & RESISTANCE CHART

DELAY & PULSE WIDTH CHASSIS (CONT'D)

TUBE	TYPE	PIN	VOLTAGE	RESISTANCE	REMARKS
V-207	6AL5	1-5	80 V	80K	
		2	-100 V	16K	
		3	225 V	10K	6.3V AC WITH RESPECT TO PIN #4.
		4	225 V	10K	6.3V AC WITH RESPECT TO PIN #3.
		6	0.0V	GND.	
		7	80 V	15K	

PULSE FORMING CHASSIS

TUBE	TYPE	PIN	VOLTAGE	RESISTANCE	REMARKS
V-301	12AT7	1	225 V	20K	
		2	-25 V	40K	
		3	-22 V	5.7K	
		4-5	6.3V AC	FIL.	
		6	360 V	210K	
		7	-7.4V	2.1K	
		8-9	0.0V	GND.	
V-302	12BH7	1	360 V	210K	
		2	-22 V	6.3K	
		3	1.5V	1.1K	
		4-5	6.3V AC	FIL.	
		6	400 V	200K	
		7	-22 V	8K	
		8-9	0.0V	GND.	
V-303	5964	1-2	400 V	200K	
		3	0.0V	GND.	
		4	6.3V AC	FIL.	
		5-6	-22 V	5.5K	
		7	6 V	29MEG	DEPENDS ON PULSE FLATNESS CONTROL.
V-304	12BH7	1-6	400 V	190K	
		2	-22 V	6.7K	
		3	3 V	1.1K	
		4-5	6.3V AC	FIL.	
		7	-22 V	8K	
		8-9	0.0V	GND.	

VOLTAGE & RESISTANCE CHART

PULSE FORMING CHASSIS (CONT'D)

TUBE	TYPE	PIN	VOLTAGE	RESISTANCE	REMARKS
V-305	5964	1-2	6 V	29MEG	DEPENDS ON PULSE FLATNESS CONTROL.
		3	0.0V	GND.	
		4	6.3V AC	FIL.	
		5-6	-150 V	5.5K	
		7	-120 V	3K	
V-306	6AU6	1	-0.5V	22MEG	
		2-3-7	0.0V	GND.	
		4	6.3V AC	FIL.	
		5-6	6 V	29MEG	DEPENDS ON PULSE FLATNESS CONTROL.
V-307	3E29	1	6.3V AC	FIL.	
		2	-65 V	500K	
		3	400 V	190K	
		4	0.0V	93 OHM	MAIN PULSE SWITCH IN + POSITION.
		5	-	-	NO CONNECTION.
		6	-65 V	500K	
		7	6.3V AC	FIL.	
		CAPS	385 V	50K	
V-308	12BH7	1	400 V	190K	
		2	6 V	29MEG	DEPENDS ON PULSE FLATNESS CONTROL.
		3-6	30 V	11K	
		4-5	6.3V AC	FIL.	
		7	-22 V	8K	
		8-9	0.0V	GND.	
V-309	6AL5	1	6 V	29MEG	DEPENDS ON PULSE FLATNESS CONTROL.
		2	-70 V	50K	DEPENDS ON AMP-LITUDE CONTROL.
		3-6-7	0.0V	GND.	
		4	6.3V AC	FIL.	
		5	-65 V	500K	DEPENDS ON AMP-LITUDE CONTROL.

REGULATOR CHASSIS

TUBE	TYPE	PIN	VOLTAGE	RESISTANCE	REMARKS
V-401	5651	1-5	-65 V	25K	
		2-7	-150 V	3K	
		3-4-6	-	-	NO CONNECTION.

VOLTAGE & RESISTANCE CHART

REGULATOR CHASSIS (CONT'D)

TUBE	TYPE	PIN	VOLTAGE	RESISTANCE	REMARKS
V-402	6AU6	1	-65 V	185K	
		2-7	-65 V	25K	
		3-6	0.0V	GND.	
		4	6.3V AC	FIL.	
		5	-17 V	4.3MEG	
V-403	6AU6	1	-4.5V	100K	
		2-3-7	0.0V	GND.	
		4	6.3V AC	FIL.	
		5	190 V	1MEG	
		6	130 V	65K	
V-404	6AU6	1	6.2V	120K	
		2-3-7	0.0V	GND.	
		4	6.3V AC	FIL.	
		5	400 V	1.1MEG	
		6	193 V	160K	
V-406	6AU6	1	4.1V	100K	
		2-3-7	0.0V	GND.	
		4	6.3V AC	FIL.	
		5	224 V	1.2MEG	
		6	135 V	80K	
V-407	12BH7	1	400 V	180K	
		2	224 V	1.1MEG	
		3	225 V	15K	
		4-5	-	10K	6.3V AC WITH RESPECT TO PIN #9.
		6-7-8	-	-	NO CONNECTION.
		9	-	10K	6.3V AC WITH RESPECT TO PIN #'s 4-5.
V-408	12B4	1	400 V	180K	
		2-7	390 V	1.6MEG	
		3	225 V	10K	6.3V AC WITH RESPECT TO PIN #'s 4-5.
		4-5	225 V	10K	6.3V AC WITH RESPECT TO PIN #3.
		6-8	-	-	NO CONNECTION.
		9	500 V	60K	
V-409	12B4	-	-	-	SAME AS V-408.

VOLTAGE & RESISTANCE CHART

MAIN CHASSIS

TUBE	TYPE	PIN	VOLTAGE	RESISTANCE	REMARKS
V-702	6AS7	1	175 V	1MEG	
		2	350 V	12K	
		3	225 V	11K	
		4	-24 V	4.5MEG	
		5	85 V	1.5K	
		6-7	0.0V	GND.	
		8	6.3V AC	FIL.	
V-801	12AU7	1-6	225 V	10K	
		2	0.0V	400 OHM	
		3	7.8V	1K	
		4-5	0.0V	GND.	
		7	0.0V	500 OHM	
		8	7.8V	1K	
		9	6.3V AC	FIL.	

TRANSFORMER

TERMINALS	VOLTAGE (VOLTS, AC)	RESISTANCE (OHMS)
1 to 3	110	.17
2 to 4	110	.17
5 to 7-23	6.3	.1
25 to 7-23	6.3	.1
5 to 25	12.6	.2
8 to 9	3.15	.05
9 to 10	3.15	.05
8 to 10	6.3	.1
11 to 12	165	22
12 to 13	165	22
11 to 13	330	44
14 to 15	210	28
15 to 16	205	28
14 to 16	415	56
17 to 18	310	18
18 to 19	310	18
17 to 19	620	36
20 to 21	295	15
21 to 22	295	15
20 to 22	590	30

ABBREVIATIONS

CER CERAMIC
COMP. COMPOSITION
EMC ELECTROLYTIC, METAL CASED
GMV GUARANTEED MINIMUM VALUE
H HENRY
K KILOHM OR 10^3 OHMS
MEG MEGOHM OR 10^6 OHMS
MF MICROFARAD OR 10^{-6} FARAD
MH MILLIHENRY OR 10^{-3} HENRY
MP METALLIZED PAPER
UH MICROHENRY OR 10^{-6} HENRY
PF PICOFARAD OR 10^{-12} FARAD
PMC PAPER, METAL CASED
PREC. PRECISION
PT PAPER TUBULAR
S MICA SILVERED MICA
V WORKING VOLTS DC
VAR VARIABLE
W WATT
WW WIRE WOUND

SYNCHRONIZING FREQUENCY CHASSIS

CAPACITORS

C-101	.1MF	PT	FIXED	400V	20%
C-102	.1MF	PT	FIXED	400V	20%
C-103	47PF	CER.	FIXED	500V	10%
C-104	470PF	MICA	FIXED	500V	10%
C-105	.01MF	CER.	FIXED	500V	GMV.
C-106	.01MF	CER.	FIXED	500V	GMV.
C-107	2-.01MF	CER.	FIXED	500V	GMV.
C-108	22PF	CER.	FIXED	500V	10%
C-109	.01MF	CER.	FIXED	500V	GMV.

DELAY LINES

D-101	1μ SEC.	PCA	DL-1000 B-1-3766
D-102	1μ SEC.	PCA	DL-1000 B-1-3766

RESISTORS

R-101	1.4MEG	PREC.	FIXED	$\frac{1}{2}$W	1%
R-102	1.4MEG	PREC.	FIXED	$\frac{1}{2}$W	1%
R-103	33K	COMP.	FIXED	$\frac{1}{2}$W	10%
R-104	33K	COMP.	FIXED	$\frac{1}{2}$W	10%
R-105	3.3K	COMP.	FIXED	2W	10%
R-106	3.3K	COMP.	FIXED	2W	10%
R-111	4.7K	COMP.	FIXED	1W	10%
R-112	4.7K	COMP.	FIXED	1W	10%
R-113	1MEG	COMP.	FIXED	$\frac{1}{2}$W	10%
R-114	4.7K	COMP.	FIXED	$\frac{1}{2}$W	10%
R-115	4.7K	COMP.	FIXED	$\frac{1}{2}$W	10%
R-116	2.2K	COMP.	FIXED	2W	10%
R-117	2.2K	COMP.	FIXED	2W	10%
R-118	2.2K	COMP.	FIXED	2W	10%
R-119	2.2K	COMP.	FIXED	2W	10%
R-120	270K	COMP.	FIXED	$\frac{1}{2}$W	10%

SYNCHRONIZING FREQUENCY CHASSIS (CONT'D)

RESISTORS (CONT'D)

R-121	22K	COMP.	FIXED	½W	10%
R-122	470 OHM	COMP.	FIXED	½W	10%
R-123	470 OHM	COMP.	FIXED	½W	10%
R-124	4.7K	COMP.	FIXED	½W	10%
R-125	82K	COMP.	FIXED	1W	10%
R-126	1K	COMP.	FIXED	½W	10%
R-127	1K	COMP.	FIXED	½W	10%
R-128	10K	COMP.	FIXED	2W	10%
R-129	20K	COMP.	FIXED	1W	5%
R-130	10K	COMP.	FIXED	2W	10%
R-131	15K	COMP.	FIXED	½W	10%
R-132	10K	COMP.	FIXED	½W	10%
R-133	470K	COMP.	FIXED	½W	10%
R-134	4.7 MEG	COMP.	FIXED	½W	10%
R-136	10K	COMP.	FIXED	½W	10%
R-137	470K	COMP.	FIXED	½W	10%
R-138	1K	COMP.	FIXED	½W	10%

TRANSFORMERS

T-101	1μSEC.	NOMINAL PULSE TRANSFORMER

TUBES

V-101	6AS6	PHANTASTRON OSCILLATOR
V-102	6AS6	PHANTASTRON OSCILLATOR
V-103	12AT7	TRIGGER AMPLIFIER
V-104	12AT7	BLOCKING OSCILLATOR
V-105	12AU7	OUTPUT CATHODE FOLLOWER
V-106	12AU7	PHANTASTRON OSCILLATOR CATHODE FOLLOWER
V-107	12AT7	SCHMIDT TRIGGER

DELAY CHASSIS

Note: This parts list is for one chassis. Two identical chassis are used, one as delay and one as pulse width.

CAPACITORS

C-201	470PF	MICA	FIXED	500V	10%
C-202	47PF	CER.	FIXED	500V	10%
C-203	47PF	CER.	FIXED	500V	10%
C-204	.01MF	CER.	FIXED	500V	GMV
C-205	470PF	CER.	FIXED	500V	10%
C-206	470PF	CER.	FIXED	500V	10%
C-207	470PF	MICA	FIXED	500V	10%
C-208	470PF	CER.	FIXED	500V	10%

DELAY CHASSIS (CONT'D)

DIODE

X-201	1N51				

INDUCTOR

L-201	1MH		FIXED		

RESISTORS

R-201	220K	COMP.	FIXED	½W	10%
R-202	100K	COMP.	FIXED	½W	10%
R-203	10K	FILM	FIXED	4W	5%
R-207	5K	FILM	FIXED	3W	5%
R-209	15K	FILM	FIXED	7W	5%
R-215	20K	FILM	FIXED	3W	5%
R-217	20K	FILM	FIXED	3W	5%
R-219	10K	FILM	FIXED	3W	5%
R-220	10K	FILM	FIXED	3W	5%
R-221	1.5K	FILM	FIXED	3W	5%
R-223	40K	FILM	FIXED	4W	5%
R-225	10K	COMP.	FIXED	2W	10%
R-226	20K	FILM	FIXED	3W	5%
R-228	10K	FILM	FIXED	3W	5%
R-230	2.2 MEG	COMP.	FIXED	½W	10%
R-231	68K	COMP.	FIXED	1W	10%
R-232	22K	COMP.	FIXED	½W	10%
R-233	470 OHM	COMP.	FIXED	½W	10%
R-234	470 OHM	COMP.	FIXED	½W	10%
R-235	4.7K	COMP.	FIXED	½W	10%
R-236	22K	COMP.	FIXED	2W	10%
R-237	220K	COMP.	FIXED	½W	10%
R-238	100K	COMP.	FIXED	½W	10%
R-239	47K	COMP.	FIXED	½W	10%

TRANSFORMER

T-201	1μSEC. NOMINAL	PULSE TRANSFORMER

DELAY CHASSIS (CONT'D)

TUBES

V-201	5687	FLIP-FLOP
V-202A	½ 6AL5	CLAMP
V-202B	½ 6AL5	COUPLING DIODE
V-203	5763	MILLER INTEGRATOR
V-204	12AU7	COMPARATOR
V-205A	½ 12AU7	CONSTANT CURRENT TUBE
V-205B	½ 12AU7	PULSE AMPLIFIER
V-206	12AU7	BLOCKING OSCILLATOR
V-207	6AL5	COUPLING DIODE

PULSE FORMING CHASSIS

CAPACITORS

C-301	220PF	S. MICA	FIXED	500V	10%
C-302	470PF	CER.	FIXED	500V	10%
C-303	.01MF	CER.	FIXED	500V	GMV
C-304	470PF	CER.	FIXED	500V	10%
C-305	.01MF	CER.	FIXED	500V	GMV
C-306	.01MF	CER.	FIXED	500V	GMV
C-307	470PF	CER.	FIXED	500V	10%
C-308	.01MF	CER.	FIXED	500V	GMV
C-309	470PF	CER.	FIXED	500V	10%
C-310	470PF	CER.	FIXED	500V	10%
C-311	1000PF	CER.	FIXED	500V	10%
C-312	.01MF	CER.	FIXED	500V	GMV
C-313	470PF	CER.	FIXED	500V	10%
C-314	.5MF	MP	FIXED	500V	20%
C-315	.01MF	CER.	FIXED	500V	GMV
C-316	.01MF	CER.	FIXED	500V	GMV
C-317	7-45PF	CER.	VAR.	500V	
C-318	7-45PF	CER.	VAR.	500V	
C-319	3-12PF	CER.	VAR.	500V	
C-320	47PF	S. MICA	FIXED	500V	5%
C-321	.01MF	CER.	FIXED	500V	GMV

RESISTORS

R-301	4.7K	COMP.	FIXED	½W	10%
R-302	2.2K	COMP.	FIXED	½W	10%
R-303	10K	COMP.	FIXED	1W	10%
R-304	1K	COMP.	FIXED	1W	10%
R-305	1K	COMP.	FIXED	½W	10%
R-306	2.2K	COMP.	FIXED	½W	10%
R-307	120 OHM	COMP.	FIXED	½W	10%
R-308	22 OHM	COMP.	FIXED	½W	10%
R-309	100 OHM	COMP.	FIXED	½W	10%
R-310	2.2K	COMP.	FIXED	½W	10%

PULSE FORMING CHASSIS (CONT'D)

RESISTORS (CONT'D)

R-311	100 OHM	COMP.	FIXED	½W	10%
R-312	1K	COMP.	FIXED	½W	10%
R-313	680 OHM	COMP.	FIXED	½W	10%
R-314	330 OHM	COMP.	FIXED	½W	10%
R-315	2.2K	COMP.	FIXED	½W	10%
R-316	1K	COMP.	FIXED	2W	10%
R-317	5K	WW	FIXED	5W	10%
R-318	2.2 MEG	COMP.	FIXED	½W	10%
R-319	10K	COMP.	FIXED	½W	10%
R-320	470K	COMP.	FIXED	½W	10%
R-321	47 OHM	COMP.	FIXED	½W	10%
R-322	47 OHM	COMP.	FIXED	½W	10%
R-323	22 OHM	COMP.	FIXED	½W	10%
R-324	220K	COMP.	FIXED	½W	10%
R-325	47K	COMP.	FIXED	½W	10%
R-326	22K	COMP.	FIXED	½W	10%
R-327	2.2K	COMP.	FIXED	½W	10%
R-328	2.2 MEG	COMP.	FIXED	½W	10%
R-329	4.7K	COMP.	FIXED	½W	10%
R-331	2.5 MEG	COMP.	VAR.	2W	10%

TRANSFORMERS

T-301	.1μSEC.	NOMINAL PULSE TRANSFORMER
T-302	.1μSEC.	NOMINAL PULSE TRANSFORMER
T-303	.1μSEC.	NOMINAL PULSE TRANSFORMER

TUBES

V-301	12AT7	AMPLIFIER
V-302	12BH7	"START" BLOCKING OSCILLATOR
V-303	5964	PULSE FORMING BLOCKING OSCILLATOR
V-304	12BH7	"STOP" BLOCKING OSCILLATOR
V-305	5964	MAIN DISCHARGE TUBE
V-306	6AU6	CLAMP
V-307	3E29	OUTPUT TUBE
V-308A	½ 12BH7	CATHODE FOLLOWER
V-308B	½ 12BH7	DISCHARGE TUBE
V-309	6AL5	D.C. RESTORATION DIODE

REGULATOR CHASSIS

CAPACITORS

C-401	.01MF	CER.	FIXED	500V	GMV

REGULATOR CHASSIS (CONT'D)

CAPACITORS (CONT'D)

C-402	.01MF	CER.	FIXED	500V	GMV
C-403	.01MF	CER.	FIXED	500V	GMV
C-405	.01MF	CER.	FIXED	500V	GMV
C-406	.01MF	CER.	FIXED	500V	GMV
C-407	.01MF	CER.	FIXED	500V	GMV
C-408	.01MF	CER.	FIXED	500V	GMV
C-409	.01MF	CER.	FIXED	500V	GMV
C-410	.01MF	CER.	FIXED	500V	GMV
C-413	.01MF	CER.	FIXED	500V	GMV
C-414	.01MF	CER.	FIXED	500V	GMV
C-415	.01MF	CER.	FIXED	500V	GMV
C-416	.01MF	CER.	FIXED	500V	GMV
C-419	.01MF	CER.	FIXED	500V	GMV
C-420	.01MF	CER.	FIXED	500V	GMV
C-421	6800PF	MICA	FIXED	500V	10%

RESISTORS

R-401	4.7MEG	COMP.	FIXED	½W	10%
R-402	22K	COMP.	FIXED	1W	10%
R-403	330K	PREC.	FIXED	½W	1%
R-404	400K	PREC.	FIXED	½W	1%
R-405	1MEG	COMP.	FIXED	½W	10%
R-406	100K	COMP.	FIXED	1W	10%
R-407	150K	COMP.	FIXED	½W	10%
R-408	230K	PREC.	FIXED	½W	1%
R-409	150K	PREC.	FIXED	½W	1%
R-410	1MEG	COMP.	FIXED	½W	10%
R-411	100K	COMP.	FIXED	1W	10%
R-412	150K	COMP.	FIXED	½W	10%
R-413	230K	PREC.	FIXED	½W	1%
R-414	150K	PREC.	FIXED	½W	1%
R-415	1MEG	COMP.	FIXED	½W	10%
R-416	220K	COMP.	FIXED	1W	10%
R-417	220K	COMP.	FIXED	½W	10%
R-418	400K	PREC.	FIXED	½W	1%
R-419	150K	PREC.	FIXED	½W	1%
R-420	47 OHM	COMP.	FIXED	½W	10%
R-421	47 OHM	COMP.	FIXED	½W	10%
R-422	15K	PREC.	FIXED	½W	1%
R-423	1MEG	PREC.	FIXED	½W	1%
R-424	47K	COMP.	FIXED	2W	10%

REGULATOR CHASSIS (CONT'D)

ELECTRON TUBES

V-401	5651	VOLTAGE REFERENCE
V-402	6AU6	AMPLIFIER
V-403	6AU6	AMPLIFIER
V-404	6AU6	AMPLIFIER
V-406	6AU6	AMPLIFIER
V-407	½ 12BH7	SERIES TUBE +225V DOUBLY REGULATED
V-408	12B4	SERIES TUBE +400V
V-409	12B4	SERIES TUBE +400V

LEFT HAND SIDE PANEL - when facing front panel

SILICON RECTIFIERS

X-531	200MA	260V. RMS MAX. INPUT
X-532	200MA	260V. RMS MAX. INPUT
X-533	200MA	260V. RMS MAX. INPUT
X-534	200MA	260V. RMS MAX. INPUT
X-535	200MA	260V. RMS MAX. INPUT
X-536	200MA	260V. RMS MAX. INPUT
X-537	200MA	260V. RMS MAX. INPUT
X-538	200MA	260V. RMS MAX. INPUT
X-539	200MA	260V. RMS MAX. INPUT
X-540	200MA	260V. RMS MAX. INPUT
X-541	200MA	260V. RMS MAX. INPUT
X-542	200MA	260V. RMS MAX. INPUT
X-543	200MA	260V. RMS MAX. INPUT
X-544	200MA	260V. RMS MAX. INPUT
X-545	200MA	260V. RMS MAX. INPUT
X-546	200MA	260V. RMS MAX. INPUT
X-547	200MA	260V. RMS MAX. INPUT
X-548	200MA	260V. RMS MAX. INPUT
X-549	200MA	260V. RMS MAX. INPUT
X-550	200MA	260V. RMS MAX. INPUT

RESISTORS

R-501	1.5K	WW	FIXED	25W	10%
R-502	1250 OHM	WW	FIXED	25W	10%
R-505	75 OHM	WW	FIXED	25W	10%
R-506	50 OHM	WW	FIXED	5W	10%
R-507	75 OHM	WW	FIXED	25W	10%
R-508	50 OHM	WW	FIXED	5W	10%

LEFT HAND SIDE PANEL (CONT'D)

TRANSFORMER

T-501	TRANSFORMER - POWER	RUTHERFORD	B2 - 1004A

RIGHT HAND SIDE PANEL - when facing front panel

RESISTORS

R-601	15K	WW	VAR.	2W	
R-602	15K	WW	VAR.	2W	
R-603	15K	WW	VAR.	2W	UPPER FREQ. ADJ.
R-604	15K	WW	VAR.	2W	
R-605	15K	WW	VAR.	2W	
R-606	15K	WW	VAR.	2W	
R-607	15K	WW	VAR.	2W	LOWER FREQ. ADJ.
R-608	15K	WW	VAR.	2W	
R-611	15K	WW	VAR.	2W	
R-612	15K	WW	VAR.	2W	
R-613	15K	WW	VAR.	2W	
R-614	15K	WW	VAR.	2W	
R-615	15K	WW	VAR.	2W	
R-616	15K	WW	VAR.	2W	
R-617	15K	WW	VAR.	2W	
R-618	15K	WW	VAR.	2W	
R-619	15K	WW	VAR.	2W	
R-620	15K	WW	VAR.	2W	
R-621	15K	WW	VAR.	2W	
R-622	15K	WW	VAR.	2W	
R-623	15K	WW	VAR.	2W	
R-624	15K	WW	VAR.	2W	
R-625	15K	WW	VAR.	2W	
R-626	15K	WW	VAR.	2W	
R-627	15K	WW	VAR.	2W	
R-628	15K	WW	VAR.	2W	

MAIN CHASSIS

CAPACITORS

C-701	125MF	EMC	FIXED	450V	-20+50%
C-702	125MF	EMC	FIXED	450V	-20+50%

MAIN CHASSIS (CONT'D)

CAPACITORS (CONT'D)

C-703	40-40MF	EMC	FIXED	450V	-20+50%
C-704	40-40MF	EMC	FIXED	450V	-20+50%
C-705	40-40MF	EMC	FIXED	450V	-20+50%
C-706	40-40MF	EMC	FIXED	450V	-20+50%
C-707	40-40MF	EMC	FIXED	450V	-20+50%
C-708	.5MF	PT	FIXED	400V	20%
C-710	.5MF	PT	FIXED	400V	20%
C-711	.5MF	PT	FIXED	600V	20%
C-714	.5MF	PT	FIXED	400V	20%

DELAY LINES

D-702	1μSEC. - PCA DL-1000B-1-3766				

RESISTORS

R-701	125 OHM	WW	FIXED	10W	10%
R-706	220K	COMP.	FIXED	2W	10%
R-707	100K	COMP.	FIXED	½W	10%
R-708	100K	COMP.	FIXED	1W	10%

TUBES

V-702A	½ 6AS7	-150V. SERIES TUBE
V-702B	½ 6AS7	+225V. SERIES TUBE

FRONT PANEL & ASSOCIATED CIRCUITS

CAPACITORS

C-801	4-30PF	CER.	VAR.	500V	
C-802	4-30PF	CER.	VAR.	500V	
C-803	100PF	S. MICA	FIXED	500V	10%
C-804	100PF	S. MICA	FIXED	500V	10%
C-805	.001MF	S. MICA	FIXED	500V	10%
C-806	.001MF	S. MICA	FIXED	500V	10%
C-807	.01MF	S. MICA	FIXED	500V	10%
C-808	.01MF	S. MICA	FIXED	500V	10%
C-809	.01MF	CER.	FIXED	500V	GMV
C-810	.5MF	PT	FIXED	600V	20%

FRONT PANEL & ASSOCIATED CIRCUITS (CONT'D)

CAPACITORS (CONT'D)

C-811	100PF	S. MICA	FIXED	500V	10%
C-812	4-30PF	CER.	VAR.	500V	
C-813	100PF	S. MICA	FIXED	500V	10%
C-814	.001MF	S. MICA	FIXED	500V	10%
C-815	.01MF	S. MICA	FIXED	500V	10%
C-816	100PF	S. MICA	FIXED	500V	10%
C-817	47PF	MICA	FIXED	500V	20%
C-818	.001MF	MICA	FIXED	500V	20%
C-819	4-30PF	CER.	VAR.	500V	
C-820	100PF	S. MICA	FIXED	500V	10%
C-821	.001MF	S. MICA	FIXED	500V	10%
C-822	47PF	MICA	FIXED	500V	20%
C-823	125MF	EMC	FIXED	450V	-20+50%
C-824	22PF	CER.	FIXED	500V	GMV
C-825	.01MF	CER.	FIXED	500V	GMV
C-826	75PF	S. MICA	FIXED	500V	10%
C-827	.01MF	CER.	FIXED	500V	GMV
C-828	.01MF	CER.	FIXED	500V	GMV
C-829	470PF	CER.	FIXED	500V	GMV

FUSE

F-801	4 AMP. "SLO-BLO" FOR 110V. OPERATION
	2 AMP. "SLO-BLO" FOR 220V. OPERATION

LIGHTS

LT-801	NE 51	BLOWN FUSE INDICATOR
LT-802	#47	PILOT

RESISTORS

R-802	1.5 MEG	PREC.	FIXED	½W	1%
R-803	150K	PREC.	FIXED	1W	1%
R-804	15K	COMP.	FIXED	2W	10%
R-805	150K	PREC.	FIXED	1W	1%
R-806	1.5 MEG	PREC.	FIXED	½W	1%
R-807	15K	COMP.	FIXED	2W	10%
R-808	50K	WW	VAR.	.5%	LINEARITY - HELICAL
R-809	50K	WW	VAR.	.5%	LINEARITY - HELICAL
R-810	50K	WW	VAR.	.5%	LINEARITY - HELICAL
R-811	330K	COMP.	FIXED	½W	10%
R-812 11	1K	COMP.	FIXED	2W	10% IN PARALLEL
R-813 5	180 OHM	COMP.	FIXED	2W	10% IN PARALLEL
R-814	100K	COMP.	VAR.	2W	10%

FRONT PANEL & ASSOCIATED CIRCUITS (CONT'D)

RESISTORS (CONT'D)

R-815	4	180 OHM	COMP.	FIXED	2W	10%	IN SERIES PARALLEL
R-816		180 OHM	COMP.	FIXED	2W	10%	
R-817	4	180 OHM	COMP.	FIXED	2W	10%	IN SERIES PARALLEL
R-818		180 OHM	COMP.	FIXED	2W	10%	
R-819	4	180 OHM	COMP.	FIXED	2W	10%	IN SERIES PARALLEL
R-820		180 OHM	COMP.	FIXED	2W	10%	
R-821	4	180 OHM	COMP.	FIXED	2W	10%	IN SERIES PARALLEL
R-822		180 OHM	COMP.	FIXED	2W	10%	
R-823	4	180 OHM	COMP.	FIXED	2W	10%	IN SERIES PARALLEL
R-824		180 OHM	COMP.	FIXED	2W	10%	
R-825	2	270 OHM	COMP.	FIXED	2W	10%	IN PARALLEL
R-826	2	270 OHM	COMP.	FIXED	2W	10%	IN PARALLEL
R-827	2	270 OHM	COMP.	FIXED	2W	10%	IN PARALLEL
R-828	2	270 OHM	COMP.	FIXED	2W	10%	IN PARALLEL
R-829	2	270 OHM	COMP.	FIXED	2W	10%	IN PARALLEL
R-830	5	470 OHM	COMP.	FIXED	2W	10%	IN PARALLEL
R-831		6.8K	COMP.	FIXED	2W	10%	
R-832		1 MEG.	COMP.	FIXED	½W	10%	
R-833	6	330 OHM	COMP.	FIXED	2W	10%	IN PARALLEL
R-834		100K	COMP.	VAR.	2W	10%	
R-835		68K	COMP.	FIXED	2W	10%	
R-836		100K	COMP.	FIXED	½W	10%	
R-837		100 OHM	COMP.	FIXED	2W	10%	
R-838		47 OHM	COMP.	FIXED	½W	10%	
R-839		1K	COMP.	FIXED	2W	10%	
R-840		1K	COMP.	FIXED	2W	10%	
R-841		1.1K	COMP.	FIXED	1W	5%	

SWITCHES

S-801	7 POLE	5 POSITION	ROTARY	FREQ. RANGE
S-802	7 POLE	5 POSITION	ROTARY	DELAY RANGE
S-803	7 POLE	4 POSITION	ROTARY	PULSE WIDTH RANGE
S-804	3 POLE	3 POSITION	ROTARY	MAIN PULSE POLARITY
S-805	SPDT		TOGGLE	TRIGGER POLARITY
S-806	SPST		MOMENTARY	SINGLE SHOT
S-807	SPST		TOGGLE	POWER
S-808	DPDT		TOGGLE	10db ATTENUATOR
S-809	DPDT		TOGGLE	10db ATTENUATOR
S-810	DPDT		TOGGLE	10db ATTENUATOR
S-811	DPDT		TOGGLE	10db ATTENUATOR
S-812	DPDT		TOGGLE	10db ATTENUATOR
S-813	SPST		TOGGLE	MATCHING RESISTOR

TUBES

V-801	12AU7	CATHODE FOLLOWERS
DR-801	6C10T	AMPERITE

IMPORTANT

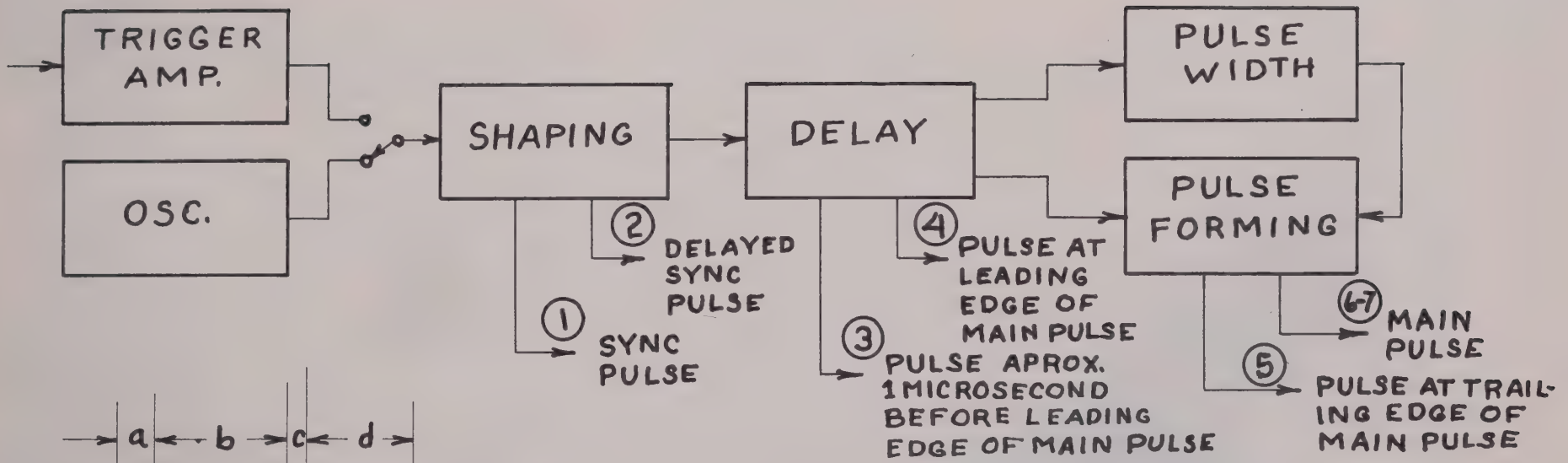
Be sure to include the INSTRUMENT MODEL and SERIAL NUMBER in all correspondence regarding any Rutherford instrument. The serial number will be found near the base of the power input cord on the rear of the Model B-2A PULSE GENERATOR.

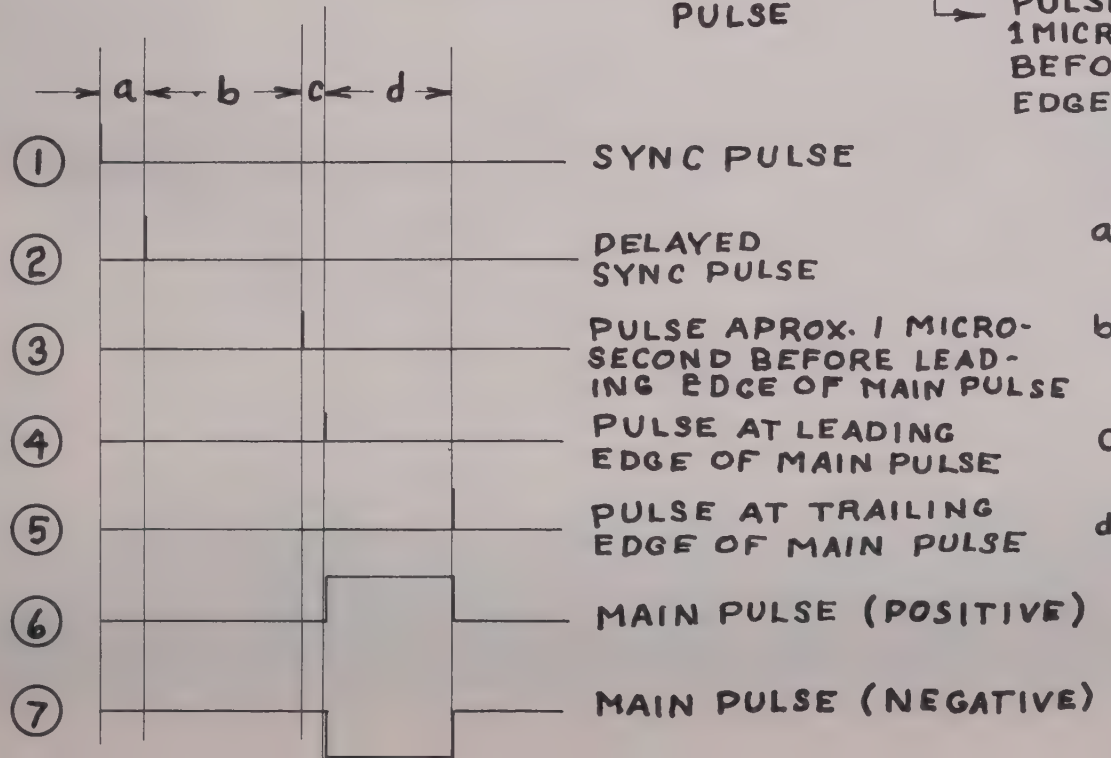
WARRANTY

Rutherford ELECTRONICS CO., guarantees to the original purchaser for a period of one year, EXCEPT vacuum tubes which are guaranteed for ninety days, that the Model B-2A PULSE GENERATOR is free from defects in material and workmanship. Our liability is limited to repair or replacement of this instrument, or any part thereof, providing failure is not due to misuse or abnormal conditions.

In order to receive service under this warranty, promptly advise the factory of all details pertinent to failure of the instrument. Replacement parts will be shipped, via air transportation if requested, prepaid to any point in the continental United States. Should it be desirable to return the instrument, ship it prepaid to the factory, and it will be serviced as required and returned via surface transportation.

Service required after the expiration of warranty, or because of misuse or abnormal conditions will be billed at cost.




a
b
c
d
1 SYNC PULSE
2 DELAYED SYNC PULSE
3 PULSE APROX. 1 MICRO-SECOND BEFORE LEAD-ING EDGE OF MAIN PULSE
4 PULSE AT LEADING EDGE OF MAIN PULSE
5 PULSE AT TRAILING EDGE OF MAIN PULSE
6 MAIN PULSE (POSITIVE)
7 MAIN PULSE (NEGATIVE)

DISCRIPTION

a FIXED BY DELAY LINE APROX. 2 MICROSECONDS

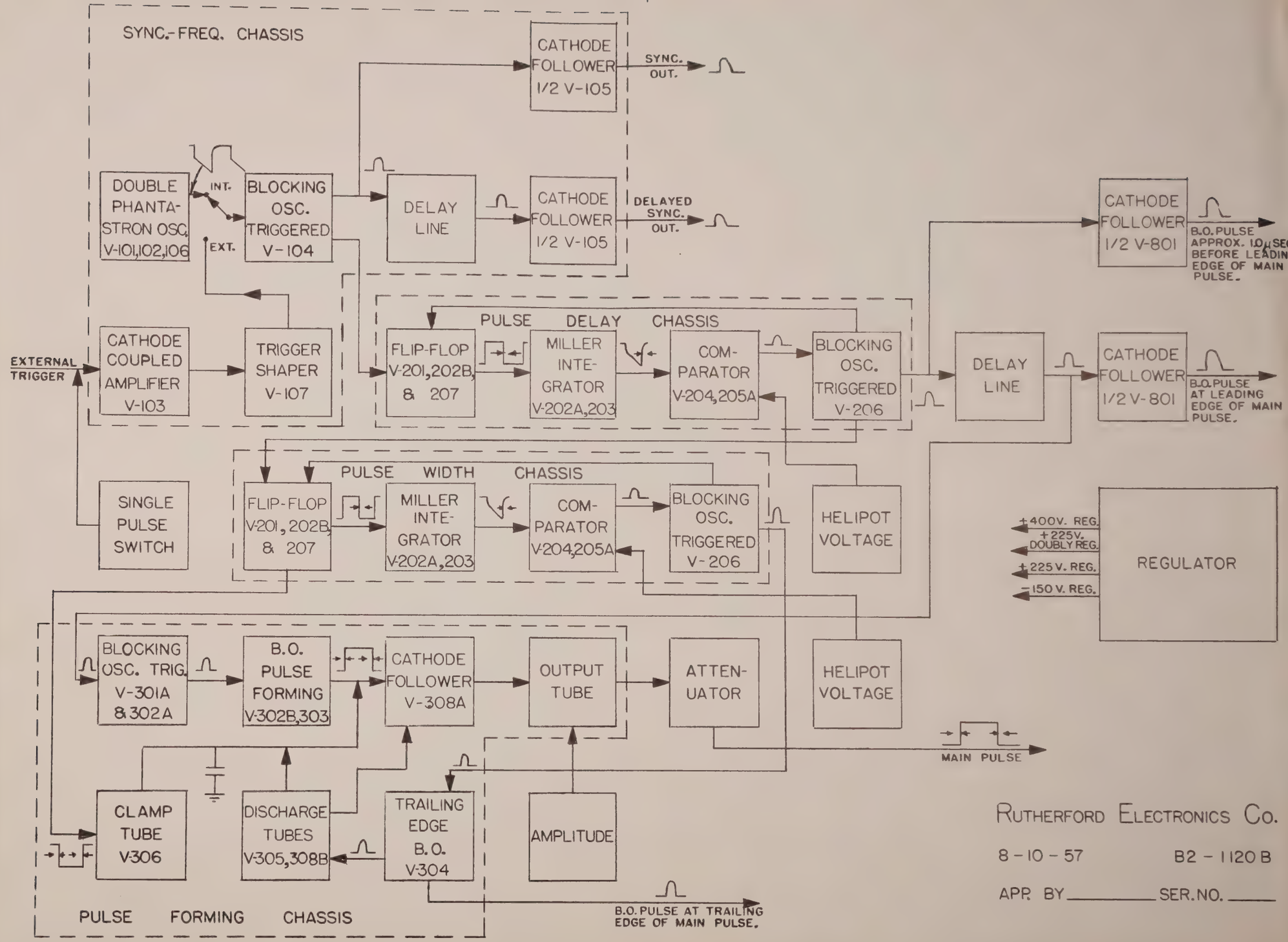
b CONTROLLED BY DELAY RANGE SWITCH AND POTENTIOMETER

c FIXED BY DELAY LINE APROX. 1 MICROSECOND

d CONTROLLED BY PULSE WIDTH RANGE SWITCH AND POTENTIOMETER

SIMPLIFIED BLOCK & TIMING DIAGRAM

B2-A-1115

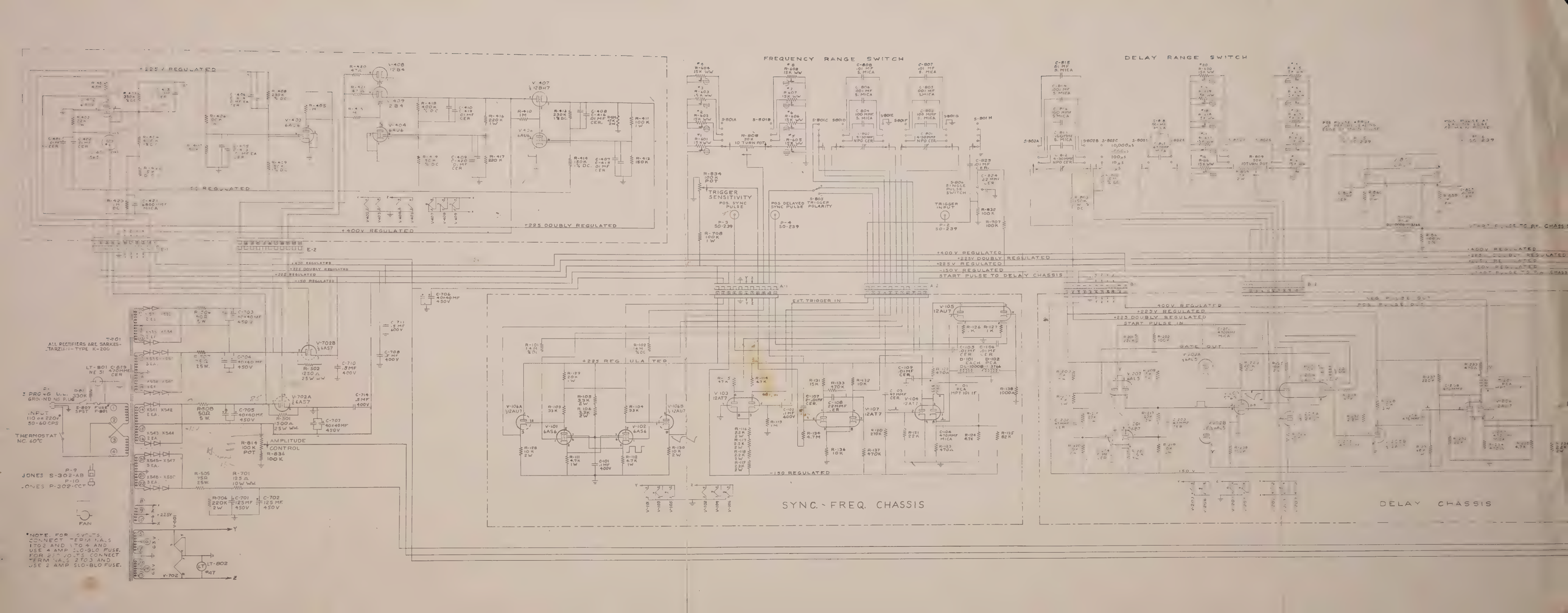


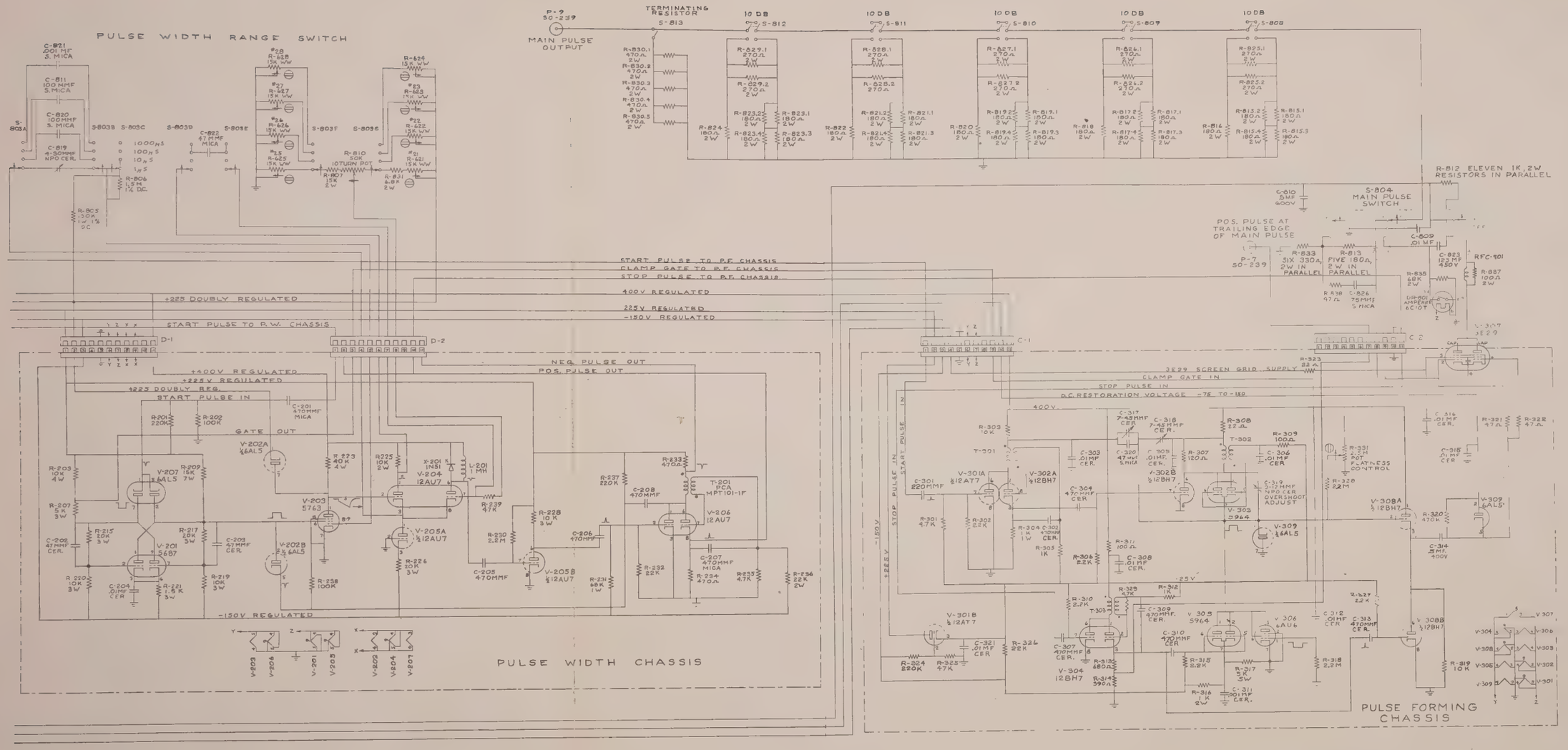
LTR	DATE	CHANGE	BY
B	8-10-57	REDRAWN FROM "A" REV	[illegible]

RUTHERFORD ELECTRONICS CO.

8 - 10 - 57 B2 - 1120 B

APP. BY _____ SER. NO. _____


+225 V REGULATED
+225 DOUBLY REGULATED
+400V REGULATED
-150 REGULATED
FREQUENCY RANGE SWITCH
DELAY RANGE SWITCH
TRIGGER SENSITIVITY
POS. SYNC PULSE
POS DELAYED SYNC PULSE
S-803 TRIGGER POLARITY
TRIGGER INPUT
S-804 SINGLE PULSE SWITCH
EXT. TRIGGER IN
START PULSE TO DELAY CHASSIS
START PULSE IN
GATE OUT
SYNC. - FREQ. CHASSIS
DELAY CHASSIS
T-701
ALL RECTIFIERS ARE SARKES-TARZIAII - TYPE K-206
INPUT 110 or 220V 50-60 CPS
THERMOSTAT NC 60°C
JONES S-302-AB
JONES P-302-CCT
FAN
AMPLITUDE CONTROL
*NOTE. FOR 220 VOLTS CONNECT TERMINALS 1 TO 2 AND 3 TO 4 AND USE 4 AMP SLO-BLO FUSE. FOR 220 VOLTS CONNECT TERMINALS 2 TO 3 AND USE 2 AMP SLO-BLO FUSE.



LETR	DATE	CHANGE	BY
D	1-9-59	C.O. # 153	V.S.
N	1-28-59	C.O. # 149	V.S.
M	12-23-58	C.O. # 133	MFC
L	12-5-58	C.O. # 25	GO
K	11-25-58	C.O. # 91	MFC
J	11-20-58	C.O. # 84	MFC
H	11-5-58	C.O. # 52	MFC
G	8-25-58	Added C 421, Rt'd. and Changed R 821	MFC
F	8-25-58	Changed R 821 to 180Ω, 2W & R 821 to 180Ω, 2W	MFC
E	8-12-58	Changed Switch Sections	MFC
D	8-12-58	Added Switch Positions & Changed Resistors	MFC
		PF Chass. Per EO 11-8	
C	11-15-57	ADDED R9, R107 THRU R116	MFC
B	10-12-57	RE DRAWN	MFC

Rutherford ELECTRONICS CO. CALIFORNIA

SCALE: NONE | APPROVED BY: | SER. NO. | DRAWN BY: Sharp

DATE: 10-12-56

SCHEMATIC

MODEL B-2 PULSE GENERATOR | DRAWING NUMBER B2-N-113010

a SHORT-FORM CATALOG of

Rutherford
PRECISION PULSE FORMING and TIMING INSTRUMENTS

10 MEGACYCLE
PULSE GENERATOR

The Rutherford Model B-5 Pulse Generator, which operates to 10 megacycles, is the highest repetition rate pulse generator commercially available. It constitutes a radical new development in high-repetition-rate, narrow-width pulse generators, giving an unparalleled combination of extremely narrow pulse widths, fast repetition rates, and fast rise times.

MODEL B-5

SPECIFICATIONS

MAIN PULSE:

PULSE WIDTH: continuously variable from .02 microsecond to 12.5 microseconds (duty factor limited to 25%) in four ranges:

.02 to .1 microsecond .5 to 2.5 microseconds
.1 to .5 microsecond 2.5 to 12.5 microseconds

AMPLITUDE: 40 volts Positive, 45 volts Negative

ATTENUATOR: 60 db in ½ db steps

RISE and FALL TIME: less than 8 millimicroseconds

POLARITY: both Positive and Negative pulses simultaneously available

OUTPUT IMPEDANCE: 185 ohms (the instrument must be terminated for proper pulse shape)

OUTPUT DECAY CONSTANT: 750 microseconds when terminated in 185 ohms

SYNCHRONIZING PULSE OUT:

15 volts positive

RISE TIME: less than .05 microsecond

WIDTH: varies with repetition rate, but is less than 700 microseconds

EXTERNAL TRIGGER:

Pulse required: 8 volts minimum with rise time less than .1 microsecond

PULSE REPETITION RATE:

Continuously variable from 1 cycle/ sec to 10 mc/sec in seven ranges:

1 c to 10 c 100 c to 1 kc 100 kc to 1 mc
10 c to 100 c 1 kc to 10 kc 1 mc to 10 mc
10 kc to 100 kc

DELAY:

A fixed delay of .14 microsecond occurs between the synchronizing pulse out and the main pulse

POWER REQUIRED:

105—125 volts, 50—60 cycles, 650 watts

CONNECTORS:

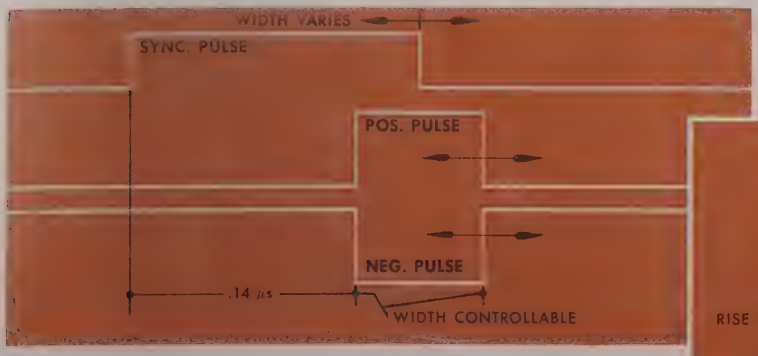
Sync. Pulse Out—type BNC
External Trigger—type BNC
Main Pulse—type C

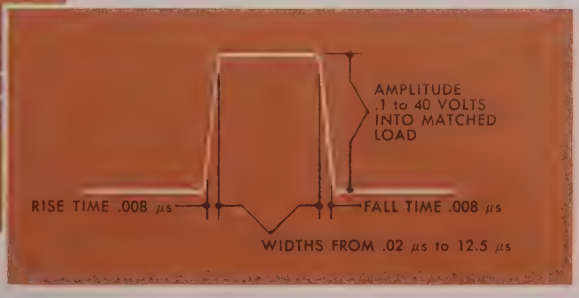
DIMENSIONS: 23" high, 23" wide, 16" deep

WEIGHT: 110 pounds

ACCESSORIES SUPPLIED:

1 unit extension cable
1 5-ft. output cable (type RG 114/U)
1 185 ohm non-inductive resistor
1 185 ohm termination assembly
1 instruction manual





DETAILS of MAIN PULSE

Rutherford ELECTRONICS CO.
Telephone: TExas 0-4362
8944 LINDBLADE STREET
CULVER CITY, CALIFORNIA

WRITE FOR COMPLETE DATA ON THESE

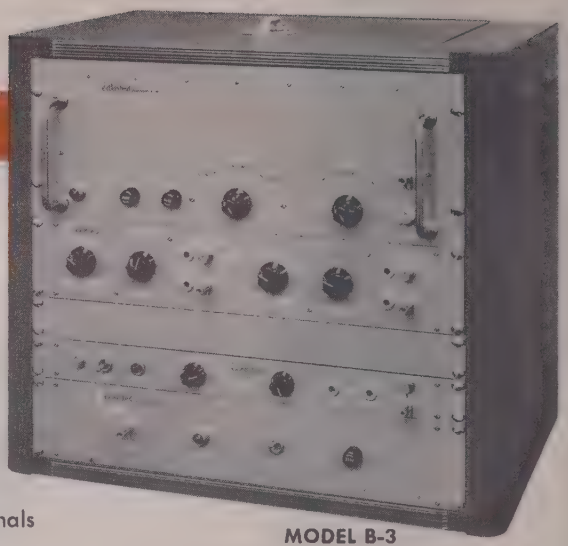
Rutherford PRECISION INSTRUMENTS

a ONE MEGACYCLE

PULSE GENERATOR

with CONTINUOUS CONTROL of REPETITION RATE, PULSE WIDTH, DELAY

The Rutherford Model B-3 Pulse Generator is a highly versatile, general-purpose instrument designed for applications involving repetition rates through one megacycle, delays from 0 to 10,000 μs, and fast rise time pulse outputs of positive or negative polarity and widths to 10,000 μs.



MODEL B-3

FEATURING:

- Pulses of either Positive or Negative polarity
- External triggering and push-button single pulse operation
- Excellent RF shielding to prevent the radiation of spurious signals
- Modular construction
- Adjustable rise time

SPECIFICATIONS

MAIN PULSE:

Widths: .08 to 10,000 microseconds

Polarity: pos. or neg. but not simultaneously

Amplitude: 20 V into 50-ohm load at 25% duty factor and 1 mc repetition rate. Amplitude increases with lower duty factors and repetition rate.

Attenuators: 50 db in 10 db steps and 10 db fill-in

Rise Time: less than 20 millimicroseconds; Fall Time: less than 25 millimicroseconds (both may simultaneously be degraded to 1 μs by single front panel control)

Overshoot and Undershoot: 4% maximum (when terminated with 50-ohm load)

Droop on Long Pulses: 10%

Duty Factor: 25% maximum at all repetition rates

INTERNAL OSCILLATOR:

Repetition Rate: 10 cycles to 1 megacycle in five decade ranges

TRIGGERING REQUIREMENTS:

External Trigger: may be triggered externally at rates from 0 to 1 megacycle

Trigger Required: 2-volt pos. or neg. pulse or 2-volt sine wave above 60 cycles per second

Single pulse control is provided

DELAY CONTROL:

Range: 0 to 10,000 microseconds

SYNCHRONIZING PULSES:

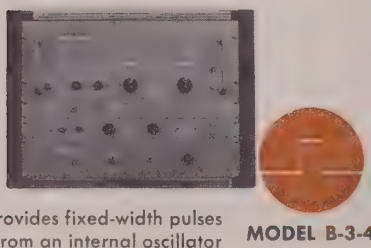
Amplitude: 10 volts minimum

Width: approximately .1 microsecond

Rise Time: approximately .05 microsecond

SIZE: 19" high, 22" wide, 18" deep

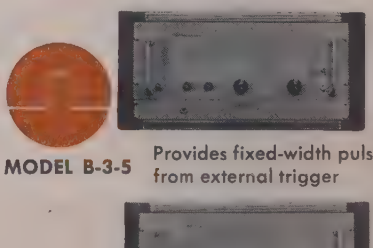
WEIGHT: 105 pounds



Provides fixed-width pulses from an internal oscillator

MODEL B-3-4

Individual units of the B-3 Pulse Generator can be assembled in many ways to provide pulses to the customer's requirements. A few combinations are shown here. We will gladly suggest assemblies for solution of your specific pulse handling problems.

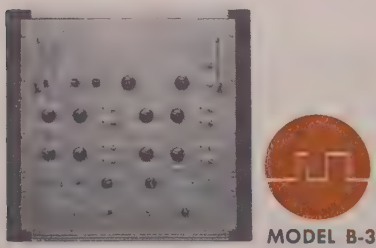


MODEL B-3-5

Provides fixed-width pulses from external trigger

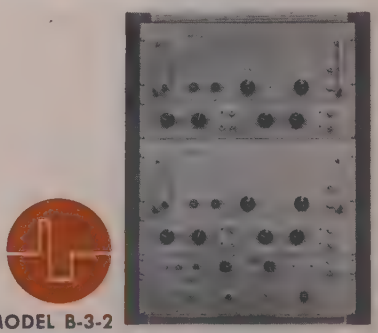
OTHER COMBINATIONS ARE AVAILABLE

WRITE FOR QUOTATIONS ON RUTHERFORD HIGH REPETITION RATE MULTIPLE-PULSE GENERATORS



MODEL B-3-3

Provides double pulses when these three conditions exist: leading edge pulse-to-pulse is greater than 1 μs; trailing edge pulse to leading edge of next pulse is greater than .5 μs; duty factor does not exceed 25%



MODEL B-3-2

Provides double pulses without restriction as to Pulse One position with respect to Pulse Two. Restricted to 1 megacycle repetition rate for each pulse of group, and to 25% duty factor for each pulse of group

ENGINEERED FOR ACCURACY, VERSATILITY AND CONVENIENCE

Created to meet the rigid standards of today's research and development laboratories.

A one-unit pulse generator combining the best features of instruments available.

Designed for high performance at low cost.

Built to the most exacting standards of precision engineering.

A highly versatile general purpose instrument

Rutherford

PULSE GENERATOR

MODEL B-7

Some of the many uses for the Rutherford Model B-7 Pulse Generator:

Basic research into high speed transistors and transistor circuits.
Magnetic core research at high up rates.
Biological research at low repetition rates.
Wide band amplifier design.
Testing of logarithmic or squaring amplifiers.
Design of high speed switching circuits.
And where high repetition rate pulse generators are generally required.

Rutherford **Electronics Co.**

8944 Lindblade Street

Culver City, California

RUTHERFORD PRESENTS

- PRECISION PERFORMANCE
- VERSATILITY
- EASE OF OPERATION
- SIMPLICITY OF DESIGN
- LOW COST

IN THE MODEL B-7 PULSE GENERATOR

SPECIFICATIONS

DELAY (with respect to Sync. Out):
0 to 1 microsecond
0 to 10 microseconds
0 to 100 microseconds
0 to 1,000 microseconds
0 to 10,000 microseconds

WIDTH (measured at 50% pulse amplitude):
.05 to 1 microsecond
.1 to 10 microseconds
1 to 100 microseconds
10 to 1,000 microseconds
100 to 10,000 microseconds

REPETITION RATE:
20 c to 200 c
200 c to 2 kc
2 kc to 20 kc
20 kc to 200 kc
.2 mc to 2 mc

AMPLITUDE:
50 volts delivered to a 50 ohm resistive lo

RISE TIME: 15 millimicroseconds

FALL TIME: 15 millimicroseconds

DUTY FACTOR:
30% duty factor at full amplitude. May
creased to 50% at reduced amplitud
automatic limiter is provided to protect t
strument against accidental overload. An
cating lamp glows during operation.

ATTENUATION:
50 db in 10 db steps. 20 db continuous c

EXTERNAL TRIGGER: Plus or minus 10 volts minimum

SYNC OUT. (synchronizing pulse):
.05 microsecond wide. 10 volts amplitude
trigger in by .2 microsecond

SIZE: 19" wide, 8¾" high, 12" deep

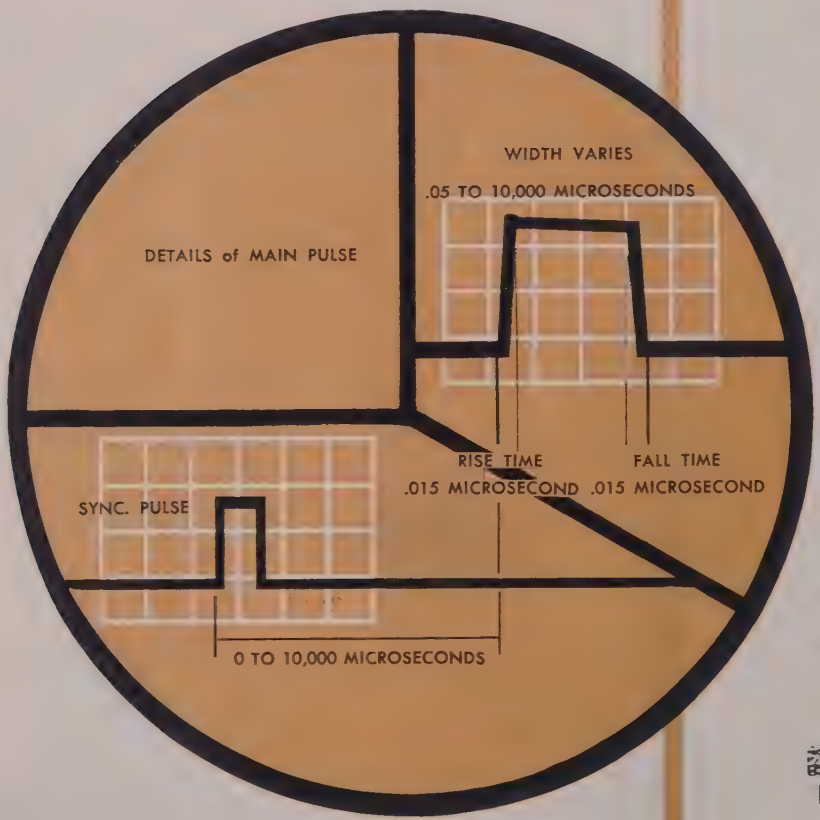
WEIGHT: 43 pounds

POWER:
105—125 volts, 50—60 cycles, 350 wat
5 amperes

PRICE: $720.00 — f.o.b. Culver City, Calif.

Other Rutherford instruments you might find useful in your laboratory:

1. High Repetition Rate Pulse Generators
2. Precision Time Delay Generators
3. General Purpose Pulse Generators
4. Versatile Modular Construction Pulse Generators
5. Special Design Pulse Instrumentation
6. 10 Megacycle Pulse Generators
7. Highly Accurate Pulse Generators
8. Variable Rise Time Generators
9. Low Jitter Pulse Generators
10. Multiple Pulse and Pulse Code Generators
11. Pulse Systems



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Rutherford
ELECTRONICS CO.
8944 LINDBLADE STREET
CULVER CITY, CALIFORNIA
TEXAS 0-7393

REPRESENTED IN YOUR TERRITORY BY

PULSE GENERATOR

A general-purpose instrument which produces pulses of accurately controlled widths, amplitude and time delay at low impedance

MODEL B-2A

FEATURES:

• Internal oscillator gives repetition rates from 10 cycles to 100 kc • Pulse widths from .1 μs to 1,000 μs • Rise time of .02 μs • Internal delays to 10,000 μs • Accurate, easily legible multiturn controls • Can be triggered externally and for single pulse operation • Calibrating potentiometers are provided for each range • Five synchronizing pulses at various time intervals during single repetition period • 40 volts output into 93-ohm load

SPECIFICATIONS

MAIN PULSE:

Width Ranges: .1 to 1 μs; 1 to 100 μs; .5 to 10 μs; 10 to 1,000 μs

Duty Factor: limited by current capabilities of the output tube to 25%

Amplitude: at least 40 volts into 93-ohm load

Impedance: 93 ohm maximum

Rise Time: .02 μs between 10 % and 90% points

Fall Time: .02 μs

Overshoot and Undershoot: less than 4% with matched load

Droop: can be adjusted to less than 5%

Polarity of Main Output Pulse: pos. or neg.—but NOT simultaneously

INTERNAL OSCILLATOR:

Ranges: 100 kc to 10 kc; 1 kc to 100 cycles; 10 kc to 1 kc; 100 cycles to 10 cycles

Single Pulse: switch produces step function to give a single pulse at each of the outputs

INTERNAL DELAY RANGES:

0 to 1 μs; 1 to 100 μs; 0 to 10 μs; 10 to 1,000 μs; 100 to 10,000 μs

ATTENUATOR:

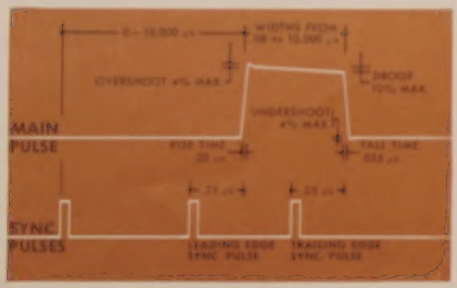
Step Attenuator: constant impedance—five Pi sections with 10 db steps

Fill-in Attenuator: 10 db variable

SIZE: Mounts on standard rack: 14" high x 19" wide. Supplied with cabinet 14" x 19" x 16½" exclusive of front panel handles.

WEIGHT: 70 pounds

NOTES ON B-3 WAVEFORMS AND TIMING



B-3 provides sync or timing signals in addition to a main pulse which has an exceptionally wide range of widths and delays.

The basic B-3 system produces waveforms detailed at left. The three sync pulses are shown on a single trace for display convenience only. Actually they are produced at three separate jacks in the instrument. The main pulse is shown as positive, but may be negative if desired. Data shown applies inverted to negative pulses.

In multiple pulse generators, appropriate timing signals defining start and stop of main pulse are used to trigger the pulse forming units.

These pulse forming units produce pulses having characteristics shown at left. Number and time relationship of pulses is controlled by the interconnections of timing and pulse forming units. Suitably connected, one timing unit may trigger one or more pulse forming units—and one pulse forming unit may be triggered by more than one timing unit.

Model B-3-3 has one pulse forming unit triggered by two timing units.

In the B-3-2 a single pulse is available from each pulse forming unit. These pulses may be used independently on individual leads or mixed through the 50-ohm mixer furnished. Both pulses are normally timed with respect to the sync pulse, but it may be connected to time one pulse from the other.

The B-3-2 instrument is a representative example of the possibilities of high speed modular pulse handling instruments.

PRICE SCHEDULE

Rutherford

TIME DELAY GENERATORS

MODEL A-2 (.8 μs to 100,000 μs delay range)	$ 650.00
MODEL A-4 (.00001 to 10 seconds delay range)	875.00

Rutherford

PULSE GENERATORS

MODEL B-2A	$ 1,080.00
MODEL B-3	1,750.00
MODEL B-3-2	3,140.00
MODEL B-3-3	2,445.00
MODEL B-3-4	1,450.00
MODEL B-3-5	995.00
MODEL B-5	2,400.00

ALL PRICES F. O. B. CULVER CITY, CALIFORNIA

ON THIS PAGE:

TWO TIME DELAY GENERATORS

Each is a precision device for the generation of accurate and variable time intervals

Model A-2:
Delay .8 through 100,000 μs
Model A-4:
Delay .00001 through 10 sec

Features Common to Models A-2 and A-4:

• Low jitter • Linear scales • Small repetition rate effects • External connector provided for delay voltage so that unit may be externally time modulated • Easily read dial controls

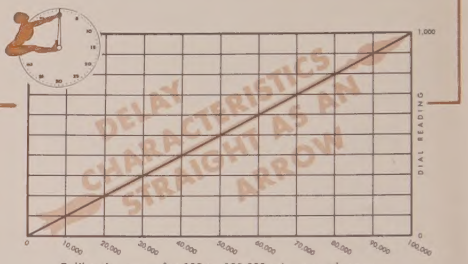
OUTPUT PULSES:

BLOCKING OSCILLATOR:
Width: .5 μs wide between 10% points
Rise Time: .1 μs between 10% and 90% points
Output Impedance: 100 ohms (.01 mfd blocking condenser)
Amplitude: 50 volts

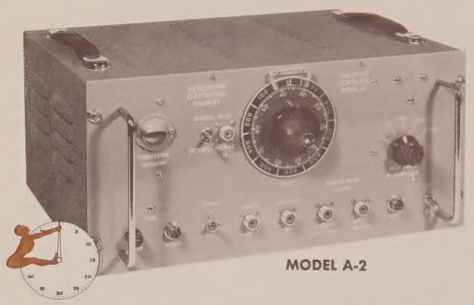
MULTIVIBRATOR:
A wide output pulse is presented for scope display
Output Impedance: 500 ohms
Amplitude: 35 volts

SIZE: 9" high; 19½" wide; 14⅞" deep over all

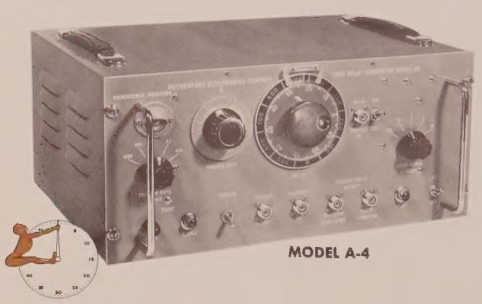
JITTER: .01 μs or .008%—whichever is greater
ACCURACY: After calibration: ± .1% full scale;
Long term: ± 1% full scale
LINEARITY: .3% or better between .1 full scale and full scale (except on .8 to 10 μs range)
EXTERNAL DELAY VOLTAGE:
150 to 50 volts . . . zero to full delay



Calibration curve for 100 to 100,000 microseconds range


MODEL A-2

Features .8 through 100,000 microseconds delay
IN FIVE DECIMALLY RELATED RANGES:
.8 to 10 microseconds — 2.5 to 1,000 microseconds
1.3 to 100 microseconds — 10. to 10,000 microseconds
100 to 100,000 microseconds


MODEL A-4

COMPLETE DATA AVAILABLE ON EACH OF THESE INSTRUMENTS

Features .00001 through 10 seconds delay
IN FIVE DECIMALLY RELATED RANGES:
.00001 to .001 second — .0001 to .1 second
.00003 to .01 second — .001 to 1. second
.01 to 10 seconds

TRIGGER PULSE OUTPUT: Same as blocking oscillator
INTERNAL OSCILLATOR—four ranges:
1,000 cps to 100 cps — 10 cps to 1. cps
100 cps to 10 cps — 1 cps to .1 cps

Rutherford

Precision Pulse Forming and Timing Instruments have achieved an enviable position in their field by virtue of
Sound Engineering
Careful Assembly
Simplified Operation

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REPRESENTATIVES IN MAJOR CITIES OF THE WORLD

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CULVER CITY, CALIFORNIA

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